Executive Summary

This document summarizes the corrective action activities and groundwater quality monitoring for the second semester of 2018 (July through December) at the Chambers Works Complex (site) in Deepwater, New Jersey. The key conclusions, updates, and recommendations for the second semester of 2018 are as follows.

Key Conclusions

- The interceptor well system (IWS) average pumping requirement of 1 million gallons per day (MGD) was met during this reporting period.
- The site IWS continues to maintain hydraulic control of the C and D aquifers.
- The sheet-pile barrier (SPB) along Salem Canal and the southwest site perimeter effectively prevents groundwater from the B aquifer in known dense non-aqueous phase liquid (DNAPL) source zones from entering the Salem Canal and Delaware River. However, under some conditions, groundwater can seep into the Salem Canal at the eastern end of the SPB. Groundwater conditions along the Salem Canal portions of the SPB, including the eastern end of the SPB, are being further investigated as part of the Supplemental Groundwater Investigations, an update to which is provided with this report.
- Hydraulic control of the B aquifer in the manufacturing area is maintained through the pumping of the IWS and the SPB. The SPB along the Delaware River was completed in the second semester of 2017. Groundwater elevation and tidal studies to demonstrate the performance of the SPB were initiated in the first semester of 2018 and will be reported in the First Semester 2019 New Jersey Pollutant Discharge Elimination System – Discharge to Groundwater (NJPDES-DGW) report.
- For the current reporting period, hydraulic control of groundwater in the E aquifer beneath the Chambers Works manufacturing area is maintained by the E aquifer pumping well J05-W01E.

Recommendations and Updates

In letters dated March 13 and April 25, 2017, New Jersey Department of Environmental Protection (NJDEP) provided comments on the Second Semester 2016 NJPDES-DGW report. In response to these comments and previous ones, the following investigations have been initiated and updates are provided herein:

- As requested by NJDEP in their comment letter dated September 11, 2014, multiple sampling programs have been completed at T29-M02B starting in March 2015. Most recently, T29-M02B was sampled for polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) in the first semester 2018. In addition, one round of sampling for PCBs was completed at surface-water stations within Bouttown Creek and Henby Creek. The purpose of the PCB sampling was to satisfy a request from the Delaware River Basin Commission (DRBC) for additional information regarding PCBs that were previously reported as being detected at well T29-M02B. Results from these sampling events were submitted to the DRBC on March 19, 2018 in the PCB Pollutant Minimization Plan Report. Based on the sampling program, SVOCs and PCBs above New Jersey Class IIA groundwater standards (NJGWIIA) remain at the location of the former removal action and concentration trends are downward. Based on previous samples collected within Bouttown Creek, there does not appear to be an ongoing discharge of site constituents from groundwater to surface water. Therefore, continued monitoring is recommended to verify declining trends of site constituents in groundwater. The next monitoring event will take place in the spring of 2019.

As a result of a February 14, 2018 meeting with the NJDEP and U.S. Environmental Protection Agency (EPA), Chemours agreed to perform the following work in the first semester of 2019:

- Chemours agreed to install and sample 19 off-site and one on-site groundwater monitoring wells at eight locations surrounding the Chemours Chambers Works Complex. This work is being undertaken to further investigate the horizontal and vertical delineation of per- and polyfluorinated alkyl substances (PFAS) in off-site groundwater as discussed at quarterly meetings between Chemours, NJDEP, and the EPA. This work is scheduled for June 2019.

Aside from the changes above, no additional changes or modifications to the current programs under Permit Nos. NJ0083429 and NJ0105872 are recommended. Existing programs will continue to be evaluated, and recommendations for modification will be made as conditions warrant.

1.0 Introduction

AECOM, on behalf of The Chemours Company (Chemours), has prepared this *Second Semester 2018 Semi-Annual NJPDES-DGW Report* for the Chambers Works Complex (site) located in Deepwater, Salem County, New Jersey (see Figure 1). The site covers 1,455 acres and comprises the former Carneys Point Works in the northern area of the site and the Chambers Works manufacturing area in the southern area of the site with Henby Creek generally separating the two. The site includes the western reach of Salem Canal, which crosses the southern portion of the site. To the south is Calpine (formerly Atlantic City Electric) Deepwater Energy Center; to the east are light industrial, residential, and recreational areas; to the north are more residential areas; and to the west is the Delaware River. The Classification Exception Area (CEA) for groundwater beneath the site is coincident with the property boundary as shown in Figure 1.

The Chambers Works manufacturing area occupies approximately 700 acres of the site and produces specialty intermediate chemicals and fluoropolymer chemicals and products. The site includes two sanitary landfills, A and B, permitted through the New Jersey Department of Environmental Protection (NJDEP) solid waste program (see Figure 2). There are several active waste handling areas, including the Resource Conservation and Recovery Act (RCRA) permitted secure landfill (Secure C Landfill), Chemical Waste Storage Area, and the wastewater treatment plant (WWTP).

The Secure C Landfill has been in operation since 1975. The landfill covers approximately 32 acres and consists of seven areas (formerly called “cells”). Area 1 of the Secure C Landfill was taken out of service in 1978 (closure was completed in 1979). Areas 2, 3, 4, 5A, 5B, and 7 are currently active and are permitted as a RCRA secure landfill. The entire landfill is lined including Area 1 and has leachate collection systems. Areas 2, 3, 4, 5A, 5B, and 7 have leak-detection systems between the liners to monitor for seepage through the upper liner.

1.1 Purpose of Report

This report fulfills the reporting requirements of the New Jersey Pollutant Discharge Elimination System - Discharge to Groundwater (NJPDES-DGW) Permit No. NJ0083429. The permit has an effective date of May 1, 2010 and expired on May 1, 2015. The most recent permit renewal was submitted on October 30, 2014 and is awaiting NJDEP approval. Therefore, Permit No. NJ0083429 is still in effect. The general requirements of NJ0083429 presented in this semi-annual NJPDES-DGW report include a status report on the site corrective action programs, recommendations for changes needed to the existing programs, semi-annual groundwater level monitoring and contour maps to evaluate site-wide groundwater control, and groundwater sampling and analysis to evaluate groundwater quality. Additionally, the required quality assurance and statistical analysis reporting are provided.

This document also fulfills the reporting requirements of NJPDES-DGW Permit No. NJ0105872, which was issued by the Bureau of Non-Point Pollution Control (BNPC) for Sanitary Landfills A and B, and Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill and has an effective date of December 1, 2013 and an expiration date of November 30, 2018. The most recent permit renewal was submitted on May 31, 2018 and is awaiting NJDEP approval. Therefore, Permit No. NJ0105872 is still in effect. Some reporting requirements for this permit are contained in the NJDEP approved Groundwater Protection Plan (GWPP), which was last revised and submitted on November 5, 2014.

Many of the reporting requirements of NJ0105872 overlap with NJ0083429, but the requirements that are exclusive to this report are the reporting on the Secure C Landfill leachate collection system and leak detection system flow data and an assessment of the GWPP.

1.2 Report Contents

The report sections are as follows:

- Section 1.0 is this introduction.
- Section 2.0 provides information on the site hydrogeology and groundwater corrective action and protection programs.
- Section 3.0 provides an evaluation of hydraulic control of on-site groundwater.
- Section 4.0 provides discussion on data quality and analysis.
- Section 5.0 discusses each of the groundwater quality and leachate collection/leak detection system monitoring programs as well as an evaluation of monitoring data.
- Section 6.0 provides a status update of ongoing remedial action development activities.
- Section 7.0 presents recommendations.
- Section 8.0 contains the references cited in this report.

Maps, charts, and tables included in this report are as follows:

- Semi-annual groundwater elevation contour maps for the following:
  - B, C, D, and E aquifers
  - A zone and B aquifer at Solid Waste Management Unit (SWMU) 5
  - B aquifer at Secure C Landfill
  - B aquifer at Salem Canal
- Maps showing the sum of the concentrations of all volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), total organic compounds, or predicted total organics by aquifer depending on the sampling completed for each reporting period.
- Trend charts of total organic carbon (TOC), total organic halogen (TOX), and total organic compound concentrations.
- Tables summarizing the instantaneous and monthly flow rates for each recovery well.
- Tables summarizing groundwater analytical results.

2.0 Site Hydrogeology and Groundwater Corrective Action and Protection Programs

This section provides information on the site hydrogeology and the groundwater corrective action and protection programs and their operational status. These programs include the following:

- A sheet-pile barrier (SPB) installed in areas along the Salem Canal and the Delaware River. The final segment of the SPB in Area of Concern (AOC) 1 was completed in December 2017.
- The leachate collection and leak detection systems for the Secure C Landfill.
- Execution of the activities that support the reporting requirements of the approved GWPP.
- Dense non-aqueous phase liquid (DNAPL) recovery, which is intended to improve groundwater quality at the site.

Appendix A provides a detailed chronology of the monitoring activities at the site. Figures 2 and 3 show the well locations at the site and indicate their purpose, e.g., recovery well, groundwater quality sampling well, etc. Figure 3A shows the sample points for the leak detection and leachate collection systems at the Secure C Landfill.

2.1 Site Hydrogeology

The *Comprehensive RCRA Facility Investigation Report* (URS, 2014) provides a detailed description of the regional and site-specific geology and hydrogeology. The following provides a brief summary of that text.

The site is characterized as a vertically stacked sequence of alternating coarser-grained and finer-grained units that generally act as aquifers and aquitards, respectively. Early in the site investigation history, a system was developed to use letters to designate primary hydrogeological units [DuPont Environmental Remediation Services (DERS), 1993]. Since then, site-investigation work has led to the on-going update and refinement of the understanding of the site hydrogeology as documented in *Interim Update: Hydrogeologic Model Refinement* (URS, December 2013), which includes 12 geologic cross-sections. The nomenclature includes a designation of an A zone, aquifers by letters B through F, and intervening aquitards by the letter designations of the bounding aquifers (e.g., the B/C aquitard lies between the B and C aquifers).

The A zone is primarily fill material. The vertical interval from the B through portions of the D aquifers correspond to the Pleistocene Cape May 3 and Cape May 2 Formations and collectively are part of the Pleistocene aquifer system. The vertical interval from portions of the D aquifer and the D/E aquitard to the crystalline basement rock corresponds to the Cretaceous Potomac Raritan Magothy (undifferentiated) Group. The D/E aquitard is a relatively, thick, hard clay between the D aquifer and the regional PRM aquifer system (DERS, 1993).

The water bearing zones of the PRM aquifer system have been designated as the E and F aquifers beneath the site. However, there are limited data at this depth beneath the site, and two distinct hydrologic zones have not been confirmed. Bedrock of the Wilmington Complex/Wissahickon Formation was encountered beneath the E and F aquifer interval at an elevation between -415 feet and -505 feet North American Vertical Datum of 1988 (NAVD88).

2.2 Engineering Control of Groundwater

There are four separate systems for hydraulic control of groundwater at the site:

- An interceptor well system (IWS) that controls groundwater in the B, C, and D aquifers
- Corrective action interceptor well program for Area 1 of the Secure C Landfill
- E aquifer control well J05-W01E
- A SPB along portions of the Salem Canal and Delaware River

Figure 2 shows the locations of the pumping wells as well as the existing SPB sections. Each pumping well is inspected daily, and groundwater flow volumes at each well are recorded. A summary of instantaneous and monthly averaged groundwater recovery rates for each well and the total gallons for each system is provided in Table 1. The following sections describe these systems in detail and provide operational status for the current reporting period.

2.2.1 Interceptor Well System (IWS)

The IWS is the primary system for site-wide groundwater control. The IWS has been in operation since 1970 and is currently pumping and treating groundwater at a monthly average rate of at least 1.0 million gallons per day (MGD).

The IWS is used to control groundwater in the B, C, and D aquifers from migrating off-site. The IWS uses seven pumping wells, designated as G08-R01C, G08-R01D, K06-R02CD, M14-R02CD, Q13-R01C, Q13-R01D, and R09-R02C (see Figure 2). The total pumping rate of the IWS was evaluated in 2009, and results of the study indicated that groundwater in the C, D, and most of the B aquifers could be controlled on-site with a decrease in the total pumping rate from 1.5 to 1.0 MGD (URS, 2010). The NJPDES-DGW Permit Number NJ0083429 that became effective on May 1, 2010 reduced the IWS pumping rate to 1.0 MGD. The remainder of the B aquifer that is not controlled by the IWS has been addressed under the engineering control of groundwater initiatives, which includes the construction of SPB to eliminate groundwater discharge as previously described.

The IWS pumping requirements were met each month during the current reporting period from July 1 to December 31, 2018. The IWS wells operated continuously except for minor shutdowns for repairs and maintenance throughout the reporting period. More significant shutdowns for this reporting period included the following:

- G08-R01C was shut down on the following days: November 19-31, December 4-5, and17-31.
- G08-R01D was shut down on the following days: August 4-5, 7-12, November 1-13, 19-31, and December 17, 31.
- K06-R02CD was shut down on the following days: November 1-2, 8-31, and December 1-8.
- M14-R02CD was shut down on the following days: July 1, August 29, September 24-26, October 12-13, and November 19, 29-30.

- Backup wells Q13-R01C and Q13-R01D were not operational during the current reporting period.
- Backup well R09-R02C was operational on the following days: October 24-27, 29, and December 1-11, 13-16.

2.2.2 Corrective Action for Area 1 of the Secure C Landfill

The groundwater recovery system for the Secure C Landfill was designed and implemented to control groundwater flow from Area 1 of the Secure C Landfill. Corrective Action wells Q20-R01B and P21-R01B are used as recovery wells. P21-R01B was operational throughout the current reporting period with minor shutdowns for maintenance and repairs. Q20-R01B was not operational in the second semester 2018 and has been shut down for major piping upgrades.

Corrective action well P21-R01B recovered groundwater at a rate of approximately 6.54 gallons per minute (gpm) during the reporting period. Hydraulic containment of Area 1 is evaluated in further detail in Section 3.2.2 of this report.

2.2.3 E Aquifer Control Well J05-W01E

Early investigations indicated that organic constituents had migrated downward and impacted groundwater within the E aquifer. Investigations of these detections within the E aquifer were documented in the *Phase IV RCRA Facility Investigation* (RFI) [DuPont Corporate Remediation Group (CRG), 2005] and the *Phase IV Supplemental Report* (DuPont CRG, 2005). Based on these investigations, it was concluded that the E aquifer is impacted only where leaky well casings allowed downward migration of constituents from the overlying aquifers. To address this issue, several suspect or known leaky wells were abandoned. Pumping from well J05-W01E began in August 1995 to control E aquifer groundwater along the southern boundary of the site. The J05-W01E control well was designed to pump 200 gpm based on groundwater modeling that defined the required capture zone as reported in the *E Aquifer Technical Memorandum* (DERS, 1996).

J05-W01E was operational during the entire current reporting period, and it pumped at an approximate rate of 237 gpm during this period.

2.2.4 Sheet-Pile Barriers (SPBs)

SPBs have been installed in areas along the Salem Canal and the Delaware River as an engineering control to prevent site groundwater from discharging off-site. Figure 2 shows the SPB sections as follows:

- Delaware River SWMU 5A/5B: The remedial action, including the installation of a SPB, was completed in 2002.
- SWMU 40: In the 1970s, a new seawall consisting of sheet-pile bulkheads was constructed to a depth of approximately -33 feet [National Geodetic Vertical Datum (NGVD)] as part of construction for a new tank along the Delaware River.
- Salem Canal: In 2008, a 900-foot long section of SPB was installed on the northern side of the canal to prevent groundwater discharge (along the AOC 6 boundary) from the B aquifer to the Salem Canal sediment and surface water. An approximate 300-foot extension for groundwater control, bank stabilization, and erosion control was installed to the Munson Dam in 2012. At the request of the

U.S. Environmental Protection Agency (EPA) and NJDEP, the effectiveness of this SPB is being further verified as part of the Salem Canal Supplemental Groundwater Investigation activities initiated in 2015. These investigations included synoptic groundwater elevation measurements, time-series groundwater elevation measurements using datalogging pressure transducers, and eight rounds of semi-annual groundwater quality sampling at selected wells. See Section 6.4.1 for details.

- Salem Canal to Delaware River SPB extension: The first phase of the extension of the Salem Canal SPB westward to and then northward along the Delaware River in AOCs 2 and 3 to SWMU 40 was completed in 2015. Construction of the AOC 1 portions of the SPB was initiated in September 2017 and was completed in December 2017. The remedial action prevents the migration of groundwater from the B aquifer to the Salem Canal and Delaware River as described in the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report* (Geosyntec, 2012). In addition, in AOC 1, the SPB penetrates the C and D aquifers as well, which limits the onshore flow of river water beneath of AOC 1 that occurs due to pumping of the site IWS.

2.3 Secure C Landfill Leachate Collection and Leak Detection Systems

Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill are designed to prevent leachate from entering the environment and are monitored in accordance with the GWPP of NJPDES-DGW Permit No. NJ0105872. These six areas of the Secure C Landfill are covered under the GWPP and are constructed using double liners. Each liner is constructed with an overlying gravity-fed collection system. This type of construction results in an upper collection/liner system [called the leachate collection system (LCS)] and a lower collection/liner system [called the leak detection system (LDS)]. The LCS removes leachate collected over the primary liner and acts as the primary conveyance for leachate generated in the landfill. The LDS is designed to remove leachate if it collects between the primary and secondary liners. This double-lined system helps to evaluate the primary liner's integrity. The LDS and LCS in each area are gravity-fed to sumps. The LCS sumps and the LDS sump for Area 5A are equipped with totalizers to measure volumetric flow rates. The LDS sumps, except for Area 5A, use counters to calculate flow rates. Figure 3A shows the locations of sumps and sample points for these systems. Volumetric flow data are summarized in Table 2A.

2.3.1 Leachate Collection System (LCS) Flow Rates

The LCS daily flow is recorded in Sump 2, Sump 3, Sump 5A, Sump 5B, and Sump 7 (see Figure 3A). Sump 2 measures the combined leachate collection flow from Areas 2 and 3 and includes the independently measured flow from leak detection systems 2-1, 2-2, 3-1, and 3-2. Sump 3 measures the leachate collection flow from Area 4 and includes the independently measured flow from LDS 4-1, 4-2, 4-3, and 4-4. Sump 5A measures the leachate collection flow from Area 5A, but the flow from the leak detection system at Area 5A is measured separately. Sump 5B measures the leachate collection flow from Area 5B and includes flow from the leak detection system. Sump 7 measures the leachate collection flow from Area 7 and includes the independently measured flow from leak detection system 7. LCS flow data from Areas 2, 3, 4, 5A, 5B, and 7 are presented in Table 2B.

2.3.2 Leak Detection System (LDS) Flow Rates

The LDS is designed to remove leachate if it collects between the primary and secondary liners. This system helps to evaluate the primary liner's integrity (see Figure 3A for LDS locations). In accordance with the Secure C Landfill operational permit, daily volumetric flow data from the leak detection sumps are reviewed for action leak rate (ALR) exceedances. The ALR is used as a metric to evaluate whether the landfill is operating as designed and is equal to 50 gallons per acre per day (gpad) for Areas 2, 3, and 4 of the Secure C Landfill. The ALR for Areas 5A, 5B, and 7 starts at 150 gpad and decreases by 10 gpad each year for the first five years of operation until the ALR reaches 100 gpad. An exceedance of the ALR does not necessarily indicate a leaking liner but does indicate that the system is not operating as designed. If the ALR is exceeded, it will be necessary to inspect and evaluate the system function in accordance with the operational permit for the landfill.

The leak detection system daily flow is recorded in the following collection sumps:

- Sump 2-1 measures flow from the western half of Area 2.
- Sump 2-2 measures flow from the eastern half of Area 2.
- Sump 3-1 measures flow from the western half of Area 3.
- Sump 3-2 measures flow from the eastern half of Area 3.
- Sump 4-1 measures flow from the southwestern quadrant of Area 4.
- Sump 4-2 measures flow from the southeastern quadrant of Area 4.
- Sump 4-3 measures flow from the northeastern quadrant of Area 4.
- Sump 4-4 measures flow from the northwestern quadrant of Area 4.
- Sump 5A measures flow from Area 5A.
- Sump 5B measures flow from Area 5B.
- Sump 7 measures flow from Area 7.

Leak detection system flow data are presented in Table 2B and are submitted to NJDEP on a semi-annual basis. Evaluation of the data based on instrumentation at the sumps and manual verification of the sumps without working instrumentation indicates that there were no ALR exceedances during the current reporting period (see Table 2B).

2.4 Groundwater Protection Plan (GWPP) Summary

The GWPP is designed to protect groundwater beyond the boundaries of the Chambers Works Complex with respect to the operational units (Sanitary A and B Landfills and Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill) in accordance with NJPDES-DGW Permit No. NJ0105872. The GWPP is evaluated continually to ensure the protection of human health and the environment. The GWPP was revised and submitted on November 5, 2014. The *Classification Exception Area (CEA) Biennial Certification Report* was submitted on November 29, 2018.

2.4.1 Sanitary A and B Landfills

The permit domain for the Sanitary A and B Landfills is defined as the uppermost aquifer (B aquifer) in the site area south of Henby Creek. Groundwater potentially impacted by the Sanitary A or B Landfills within the permit domain is controlled on-site by the IWS. In addition, a CEA covers the Chambers Works Complex, which includes the Sanitary A and B Landfills (see Figure 2). This CEA identifies constituents that exceed the New Jersey Class IIA groundwater standards (NJGWIIA) for the underlying aquifers. During the current reporting period, the IWS was effective at controlling groundwater within the permit domain (see Section 3).

2.4.2 Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill

The permit domain for the Secure C Landfill is defined as the uppermost aquifer (B aquifer) in the area within 500 feet of the landfill. Groundwater potentially impacted by the Secure C Landfill within the permit domain is captured by the Corrective Action recovery wells so that groundwater quality outside the permit domain is protected. In addition, the Secure C Landfill is within the boundary of the site CEA. This CEA identifies constituents that exceed the NJGWIIA for the underlying aquifers. Groundwater control is achieved at the Secure C Landfill while the groundwater recovery wells are operating. At the request of NJDEP in letters dated March 13 and April 25, 2017, two shallow (B aquifer) wells were constructed west of the C Landfill between the landfill and the Delaware River. The purpose of these wells was to collect the data necessary to evaluate groundwater flow and water quality characteristics in this area to confirm groundwater control west of Secure C Landfill. Water levels and the sampling at these were included in second semester DGW activities and are reported in the appropriate sections below.

A capture zone continues to be demonstrated during the current water-level measurement event. Evaluation of the Detection Monitoring Program and the Leachate Collection Monitoring Program was conducted in accordance with the GWPP.

2.5 Non-Aqueous Phase Liquid (NAPL) Survey and DNAPL Recovery Program

In September 1999, a site-wide non-aqueous phase liquid (NAPL) survey program was initiated in support of the overall RCRA Corrective Action Program to 1) identify specific well locations where either light non-aqueous phase liquid (LNAPL) or DNAPL was present and 2) determine the feasibility of recovering DNAPL from specific wells.

During the initial survey, NAPL was detected in 14 out of the approximately 350 on-site wells. Of these 14 wells, three were found to contain recoverable quantities of DNAPL: two on-site monitoring wells (L13-M01B and I12-M01B) and one interceptor well (H11-R01CD). In 2001, a monthly NAPL survey and recovery program was initiated to monitor the 14 original wells for the presence of NAPL, and the accumulated DNAPL was removed if present. Since then, all newly installed monitoring wells are screened for NAPL and added to the program as appropriate. There are currently 20 wells in the NAPL survey program. Field results for the current reporting period are summarized in Table 3.

Accumulated DNAPL is typically removed with a bailer unless the well is able to yield a sufficient volume to warrant the installation of a fixed recovery system. Fixed recovery systems are currently in use at two wells: F09-M03B and F10-P01B, which were found to be productive NAPL wells and were placed on fixed recovery systems in the fall of 2017.

3.0 Evaluation of Hydraulic Control

The depth to groundwater was measured in site wells on October 23, 2018 (see Appendix B).

A data logger located on the southern portion of the site at benchmark C13-BM01 (see Section 3.2) recorded surface-water elevations in the Delaware River. The average water level for the Delaware River is estimated with a moving mean average surface-water elevation, which is calculated using the formula by Serfes (1991). The moving mean average calculated for the Delaware River for the current reporting period was 0.14 feet NAVD88. Measured surface-water elevations in the B Basin (H16-BM02) and the Salem Canal (E05-BM01) were also used as boundary conditions for contouring the B aquifer. Additional surface-water level data used in the contouring are identified as benchmarks on the maps for reference (e.g., E05-BM02, H16-BM02, L19-BM02, T16-BM01, U30-BM01, and X24-BM01).

Groundwater elevation data were examined to identify points that are not representative of the prevailing groundwater surface elevation in the aquifer. Observed inconsistencies could be due to measurement error or some other interference, such as non-steady groundwater levels following the removal of the well cap or recent changes to pumping rates. Once identified, anomalous data points are removed and are not used in contouring the groundwater elevation data.

Groundwater elevation contour maps were produced for the A zone (in the area of SWMU 5) and site-wide for the B through E aquifers to determine if control of site groundwater was maintained by the site IWS and other passive controls (see Figures 4 through 8). A Contour Map Reporting Form for each contour map is located in Appendix C.

While the groundwater elevation contour maps indicate the general directions of horizontal groundwater flow, there are hydraulic head differences between the aquifers (from pumping) that indicate a downward leakage through the aquitards or a direct groundwater flow connection between the aquifers where the aquitards are not present. Downward vertical hydraulic gradients are prevalent across the site, especially in the proximity of the pumping wells. However, in areas with a relatively thick section of aquitard between two aquifers, the vertical leakage or flow component may be limited. For example, in the central portion of the manufacturing area for the B and C aquifers, there are relatively large differences in hydraulic head near the pumping wells in the C and D aquifers; however, with a relatively thick B/C aquitard in this area, the vertical flow component may not be significant.

3.1 A Zone at SWMU 5

The groundwater elevation contour map for the A zone is presented in Figure 4. This figure also shows the slurry and sheet-pile hydraulic barriers constructed in the SWMU 5 area as well as the H16-BM02 surface-water benchmark and the B Basin. The slurry wall does not extend to the depth that the SPB does; therefore, it is the SPB that prevents groundwater flow to the Delaware River. The October 2018 groundwater measurements (see Figure 4) show groundwater mounding near the slurry wall and SPB and groundwater moving to the south-southeast. This movement is away from the Delaware River and towards the B Basin, which is hydraulically connected to the A zone.

In summary, the slurry and sheet-pile walls in the SWMU 5 area hydraulically contain the groundwater flow.

3.2 B Aquifer

3.2.1 General Recharge and Discharge Characteristics

For the Carneys Point area, groundwater entering the B aquifer is primarily from infiltration of precipitation and secondarily from surface-water sources and aquifer areas off-site to the north and east. Groundwater leaving the B aquifer includes discharge to surface water, flow into the manufacturing area, and downward flow into the C aquifer.

For the manufacturing area, groundwater entering the B aquifer is primarily from infiltration of precipitation and secondarily from non-contact cooling water discharge into ditches, surface-water sources, and from aquifer areas off-site to the east. Groundwater leaving the B aquifer includes discharge to creeks and basins, downward flow into the C aquifer, and discharge to surface water at several locations along the site perimeter, predominantly to the Delaware River along the northwestern perimeter. Starting in 2008, discharge to surface-water bodies has been controlled by the installed SPB extending from the Salem Canal to the Fuel Tanks north of AOC 2. Installation of the SPB along the Delaware River through AOC 1 was completed in December 2017. Unlike the previous sections of the SPB, the SPB in AOC 1 penetrates the B, C, and D aquifers, effectively controlling groundwater in all three aquifers in AOC 1.

At the request of the EPA and NJDEP, the effectiveness of the SPB is being verified as part of the Salem Canal Supplemental Groundwater Investigation activities initiated in 2015. These investigations include synoptic groundwater elevation measurements, time-series groundwater elevation measurements using datalogging pressure transducers, and eight rounds of semi-annual groundwater quality sampling at selected wells. See Section 6.4.1 for details. The effectiveness of the SPB in AOCs 1, 2, and 3 will be evaluated through an ongoing tidal study that will evaluate the tidal signals in the on-site aquifers before and after the completion of the SPB. The results of these investigations will be reported in the AOC 1, 2, 3 SPB remedial action report, which was submitted in February 2019.

3.2.2 B Aquifer Head Distribution Analysis

The groundwater elevation contour map for the B aquifer is presented in Figure 5. Water level data at wells D11-M01B, G06-M03B, J05-M02B, I12-M02B, and K12-M01B were identified as anomalous during the October 2018 event and were not used in contouring the groundwater elevation. Groundwater measurements at G06-M03B are regularly higher than other B aquifer wells in the area. G06-M03B is known to be shallower than other B aquifer wells and also contains DNAPL. For these reasons, although water levels will be collected, G06-M03B will not be included in future groundwater mapping events. Wells in the K12 well cluster, i.e., K12-M01B, K12-M01C, and K12-M01D, are regularly inconsistent with other wells. The conditions at the K12 well cluster will be investigated to determine if these wells have been damaged or miss-identified. Recommendations for the continued use of these wells will be provided in the next DGW report. I12-M02B is also inconsistent with other surrounding wells and was not used in contouring the groundwater elevation.

Based on the October groundwater measurements (see Figure 5), groundwater elevations decrease from their highest points in the southwest along the Salem Canal and the Delaware River SPB to the north and east. Further, there is a rapid drop in groundwater elevation across the SPB where it separates groundwater in the B aquifer from the influence of adjoining surface water. These conditions reflect the influence of the SPB to control groundwater by directing groundwater movement away from the canal and river and towards thinning areas of the B/C aquitard, which allows the groundwater to seep into underlying aquifers where is it captured by the site IWS. Groundwater elevation data collected at the eastern end of SPB along the Salem Canal suggest that under certain conditions, groundwater may seep around the end of the SPB and enter the Salem Canal. This area is included in and will be evaluated as part of the supplemental groundwater investigations that were initiated as requested by the EPA and NJDEP (URS, 2014). The semi-annual update to this ongoing work is provided in Appendix G of this report.

Based on surface-water elevation of the Delaware River, there is an inward groundwater gradient along the western perimeter of the Carneys Point portion of Chambers Works. Moving southward, the inward gradient becomes more pronounced near AOC 1. This is due to the influence of the Corrective Action interceptor well program that controls groundwater at the Secure C Landfill. Water levels at the newly constructed wells, O21-M01B and P22-M01B, support the determination of an inward gradient and groundwater control at the Secure C Landfill.

Inward hydraulic gradients are also present along the northeastern perimeter due to natural groundwater flow onto the site as groundwater in the B aquifer migrates towards and discharges to the wetland areas of Henby and Bouttown creeks. At the request of NJDEP in letters dated March 13 and April 25, 2017, two shallow (B aquifer) wells, AA25-M02B and Z28-M02B were constructed to monitor groundwater along the northeastern property boundary. Groundwater elevations from these wells support the determination of groundwater flow onto the Chambers Works site, which then discharges to the surface waters, wetlands, and tributaries of Henby and Bouttown Creeks.

Inward (surface water moving to groundwater) gradients are often observed along the eastern reach of Salem Canal where there is no SPB. During this reporting period, the elevation measured for Salem Canal was -1.41 feet NAVD88 and is being considered anomalous due to recent construction work performed at the Munson Dam. Previous water levels collected as part of the Supplemental Groundwater Investigations have indicated that water levels of wells between the canal and the SPB (i.e., H05-M01B) are generally coincident with that of the surface level of the canal. Therefore, based on measurements at these wells, the surface of Salem Canal is estimated to be approximately 0.4 feet NAVD88. Towards the north, groundwater flows northward due to the influence of the site IWS system. Although site constituents have been detected above NJGWIIA at well I05-M01B, there are no exceedances at the other wells along the eastern reach of Salem Canal where the SPB is not present. Groundwater flow at the eastern end of the SPB is being further evaluated as part of the supplemental groundwater investigation (URS, 2014) to ensure that conditions are protective. The semi-annual update to this work is provided in Appendix G of this report.

Lower groundwater elevations are regularly observed in the western area of the former basins (near wells H15-M01B and H13-M01A). These groundwater elevations are generally consistent with the surface-water elevation measured at H16-BM02 and suggest that the controlled water level of the storm water basin locally influences groundwater elevations in this area. Groundwater elevations are also typically low near the former A Basin at wells M15-M01B, L15-M01B, and K13-M02B. The depressed water levels in these areas are due to the influence of the IWS pumping in the C and D aquifers and a thin or missing B/C aquitard. Groundwater elevations are also lower within the pumping zone of the P21-R01B and Q20-R01B pumping wells for the Secure C Landfill area.

Based on the groundwater elevation contours around the Secure C Landfill, which includes water levels measured at the two newly installed wells, O21-M01B and P22-M01B that were requested by NJDEP, groundwater is effectively being controlled by pumping at P21-R01B and Q20-R01B. Pumping wells P21-R01B and Q20-R01B capture groundwater from Area 1, Area 2, and portions of Areas 3, 4, 5A, 5B, and 7.

The contours around the SWMU 5 area show that groundwater elevations near H17-M03B, which is near the slurry wall next to the river, are elevated compared to other wells that are similarly near to the river. Such elevations are typical for this area and indicate that the slurry wall is physically preventing groundwater from discharging to the Delaware River in the area.

Groundwater elevations north of the SPB along Salem Canal (see Figure 2 in Appendix G), e.g., F05-M04B, G05-P03B, and H05-M03B, are about 1 foot higher than nearby wells on the southern side of the SPB (F05-M05B, G05-M08B, and H05-M01B, respectively). These elevations indicate that the SPB is effectively preventing groundwater flow from the B aquifer to the Salem Canal and that groundwater is now migrating from west to east where groundwater modeling indicates that the groundwater will migrate downward through thin zones of the B/C aquitard into the C aquifer where it is captured by the IWS. As previously discussed, groundwater elevation data collected at the eastern end of SPB along the Salem Canal suggests that under certain conditions groundwater may seep around the eastern end of the sheet-pile wall and enter the Salem Canal. This area is evaluated as part of the supplemental groundwater investigations.

3.3 C Aquifer

3.3.1 General Recharge and Discharge Characteristics

Groundwater entering the C aquifer includes recharge from the B aquifer and aquifer areas off-site to the west, north, east, and south. Groundwater leaving the C aquifer includes groundwater extraction from pumping wells and the potential for downward flow into the D aquifer.

3.3.2 C Aquifer Head Distribution Analysis

The groundwater elevation contour map for the C aquifer is presented in Figure 6. IWS wells M14-R02CD, K06-R02CD, and G08-R01C were actively pumping during the October 2018 groundwater measurement activity. Similar to the B aquifer, groundwater elevation data were examined to identify points that are not indicative of the prevailing groundwater surface elevation in the aquifer. For the October 2018 event, the water-level data at wells H04-M01B, J05-M01B, K06-M01C, K12-M01C, R19-M01C, and S11-M01C were identified as anomalous. In addition, wells H11-R01CD and K02-W01CD each penetrate multiple aquifers. Therefore, their groundwater elevations were not used to create the C aquifer groundwater elevation map.

Cones of influence are visible for each operating IWS well. Due to additional drawdown attributed to turbulent flow through a well screen, and other well losses, water levels measured at an active pumping well are not representative of the potentiometric surface in the surrounding aquifer. The water levels at G08-M01C, K06-M01C, and M14-M01C were used in conjunction with other nearby monitoring well data to estimate a representative potentiometric surface elevation at the corresponding pumping well by means of a semi-logarithmic projection of water levels to the pumping well. These estimated values at the pumping wells were then used in the contouring. Groundwater remains controlled with inward gradients (flow onto the site from off-site) along the entire manufacturing area perimeter (area of required groundwater capture) while the IWS is active. Therefore, the IWS effectively controls groundwater in the C aquifer.

3.4 D Aquifer

3.4.1 General Recharge and Discharge Characteristics

Groundwater entering the D aquifer includes potential recharge from the C aquifer and aquifer areas off-site to the west, north, east, and south. Groundwater leaving the D aquifer includes groundwater extraction from pumping wells and potential downward flow into the E aquifer; however, the underlying D/E aquitard effectively eliminates hydraulic connection between the D and E aquifers.

3.4.2 D Aquifer Head Distribution Analysis

The groundwater elevation contour map for the D aquifer is presented in Figure 7. IWS wells K06-R02CD, and M14-R02CD were actively pumping during the October 2018 groundwater measurement event. Based on a review of the data, the water levels at wells H07-M01D, J05-M01C, R08-M01D, and S11-M01D were considered to be anomalous and were not used in the creating the groundwater map.

Cones of influence are visible for each operating IWS well. As described above for the C aquifer, representative groundwater elevations were estimated at the pumping wells K06-R02CD and M14-R02CD. These values were then used in the contouring of the potentiometric surface for the D aquifer. Groundwater remains controlled with inward gradients (flow onto the site from off-site) along the entire manufacturing area perimeter (area of required groundwater capture) while the IWS is active. Therefore, the IWS effectively controls groundwater in the D aquifer.

3.5 E Aquifer

The groundwater elevation contour map for the E aquifer is presented in Figure 8. Well J05-W01E was pumping during the December 2018 groundwater measurement activity. The groundwater elevation contour map shows that groundwater generally flows toward the southern property boundary. When the J05-W01E pump is on, groundwater in the E aquifer beneath the manufacturing area is controlled by this pumping well.

4.0 Analytical Quality Assurance Program

The NJPDES-DGW Permit Nos. NJ0083429 and NJ0105872 require submission of a semi-annual report detailing the quality assurance activities for the reporting period. In compliance with this requirement, AECOM is providing this *Chambers Works Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report* (QAR; AECOM, April 2019) as Appendix D.

During the current reporting period, the percentage of wells sampled as scheduled and the percentage of analytical results determined to be complete were both 100%. There were no holding time violations. This performance level meets the data quality objectives. One audit of field operations, conducted on July 25, 2018, confirmed compliance with the permit sampling protocol requirements. A laboratory system performance audit of Eurofins Lancaster Laboratories, Inc. was conducted in October 2014. The audit results indicated that the laboratory procedures consistently provide usable, high-quality results needed to demonstrate compliance. Any program-specific metrics that may be identified in the QAR are discussed further in the subsections of each program in Section 5.

The QAR indicates that all samples were collected in compliance with the groundwater monitoring programs, as defined in Permit Nos. NJ0083429 and NJ0105872.

4.1 Field Parameters and Analytical Results

The groundwater monitoring schedule is summarized in Table 4, and the analytical results for the current reporting period are presented in Tables 5 through 13.

In accordance with EPA guidance documents (EPA, 1989 and 1992), Chemours developed a process for correlating the sum total concentration of individual organic constituents (VOCs and SVOCs) in a groundwater sample to measurements of TOC and TOX from that same sample. The relationship of summed organic constituent concentrations to the sum of TOC and TOX measurements from that same well is variable and well dependent. To address this condition, a well-specific correction factor has been developed for each well in the Closure and Post-Closure Groundwater Monitoring Program for the A, B, and C Basins. Therefore, using the sum of the TOC and TOX measurements multiplied by the well correction factor can provide a nominal prediction of summed total organic constituent concentrations (predicted concentrations). These predicted concentrations are then graphically evaluated for increasing or decreasing trends in site constituents in groundwater samples.

Organic analyses were required for the seven wells of the Closure and Post-Closure Groundwater Monitoring Program (CPC) for the A, B, and C Basins and the 37 wells of the Perimeter Monitoring Program (PMP) during the reporting period. The values for total predicted organic constituent concentrations are plotted on a concentration scaled symbol map (see Figures 9 through 11). Plots of TOC, TOX, and total predicted organic constituents versus time for these wells are found in Figures 12 and 13, and the values are shown in Table 5 and 6A. Results for the equipment blanks and trip blanks are shown in Table 12. Of the seven wells in the CPC, five wells exhibit no increasing or decreasing trend, one well shows a decreasing trend, and one shows an increasing trend. Rising predicted organic concentrations at L14-M01B could possibly be due to the influence of nearby pumping well M14-R02CD as well as the cessation of pumping from H11-R01CD in 2009. Of the 37 wells in the PMP, 32 wells exhibit no increasing or decreasing trend, one well shows and increasing trend, and four wells show a decreasing trend. These charts show site conditions are generally unchanging.

4.2 Summary of Statistical Report

A statistical analysis as required under Permit Nos. NJ0083429 and NJ0105872 (see Appendix E, *Second Half 2018 Semi-Annual Statistical Review of Groundwater Monitoring Results,* AECOM, April 2019) was conducted. The purpose of this evaluation is to determine, based on a review of the new and existing data, if there is a continuing change to site conditions that would compromise the efficacy of remedial programs or indicate that additional investigations into changing site conditions is needed.

These statistical analyses were conducted to interpret the analytical data and identify significant trends in groundwater quality parameter concentrations. A total of 1,129 data sets was evaluated during this reporting period. These data sets are merged with historical results and are used in the statistical analyses, as described in Appendix E.

The statistical review for the monitoring program for the current reporting period indicated that site conditions are generally unchanged. As previously reported, departures from historical baseline conditions have been observed at some wells for some parameters. Also, as previously observed constituents exhibiting statistically significant, though subtle, upward and downward trends are seen at a few wells. However, these changes do not suggest a change of site conditions or imply that groundwater is not under control at the site perimeter. The statistical monitoring program will continue to be reviewed each semester to determine if there is a change to site conditions that may need to be evaluated further.

5.0 Evaluation of Groundwater Quality

In compliance with the NJPDES-DGW Permit Nos. NJ0083429 and NJ0105872, 52 wells were sampled for the four groundwater monitoring programs below (see Table 4 and Figure 3). Some of the wells are sampled under multiple monitoring programs. The programs for the second semester of 2018 include the following:

- Closure and Post-Closure Groundwater Monitoring Program for the A, B, and C Basins (seven wells) (Permit No. NJ0083429) (see Section 5.1)
- PMP (38 wells) (Permit No. NJ0083429) (see Section 5.2)
- Post Closure Monitoring for RCRA Units (four wells) (Permit No. NJ0083429) (see Section 5.3)
- Perfluorooctanoic Acid (PFOA) Monitoring Program (36 wells) (Permit No. NJ0083429) (see Section 5.4)
- Secure C Landfill Corrective Action Monitoring Program (five wells) (Permit No. NJ0105872) (see Section 5.5)
- Secure C Landfill Detection Monitoring Program (four wells) (Permit No. NJ0105872) (see Section 5.6)

Groundwater quality is monitored in two wells (S24-M01B and T22-M01B) to characterize background for both corrective action and detection monitoring programs at the Secure C Landfill.

The following program did not require sampling during this reporting period as outlined in Table 4:

- Leachate Collection System Monitoring Program (Permit No. NJ0105872) (see Section 5.7)

Table 4 summarizes the groundwater sampling schedule. The table denotes the required sampling locations, analytes, frequency, and the scheduled sampling event. Each monitoring program is listed separately. Parts 1 through 5 of Table 4 refer to the Corrective Action groundwater monitoring programs (No. NJ0083429). Part 6 refers to Post-Closure Monitoring for the RCRA Units, while Parts 7 and 8 refer to the detection monitoring and leachate characterization for Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill (No. NJ0105872). Part 9 refers to the PFOA Monitoring Program.

There were no modifications made to the monitoring programs during the current reporting period. Appendix A presents the complete chronology of previous modifications to monitoring programs and includes historical information and modifications to the Secure C Landfill monitoring programs.

5.1 Closure and Post-Closure Groundwater Monitoring for the A, B, and C Basins

The closure and post-closure monitoring program for the A, B, and C Basins monitors groundwater quality in the following seven wells around the perimeter of the basins:

- G16-M02B
- H13-M02B

- H14-M01B
- H16-P01B
- K13-M02B
- J16-M01B
- L14-M01B

The purpose of this sampling is to monitor groundwater quality to ensure that the closure is protective of human health and the environment and that conditions have not changed that may warrant further evaluation. Parts 1 and 2 of Table 4 summarize the frequency and analytical parameters for the closure and post-closure monitoring of the A, B, and C Basins. All seven of these wells were monitored for the Basin Closure Monitoring Program Analyte List (see Table 4, Part 2).

5.1.1 Quality Assurance

The electronic data submitted for this program were reviewed via the Environmental Information Management (EIM) Data Verification Module (DVM). Analytical results for the current reporting period are provided in Table 5. Results for the equipment blank and trip blanks can be found in Table 12. The laboratory performance audit results show that most qualifiers occurred due to problems with quality control batch matrix spike recovery or reproducibility. Qualification based on matrix quality control samples normally indicates a matrix effect within a given sample but does not indicate poor laboratory performance. Evaluation of laboratory control samples confirmed proper laboratory system performance, expect as noted, indicating that the analyses were performed properly under "in control" conditions. The DVM identified some limitations with the data. A more detailed discussion of the program-specific DVM results can be found in the QAR (see Appendix D).

5.1.2 Analyses and Discussion

Statistical analyses conducted on the groundwater parameters and wells in the basin closure and post-closure program are presented in Appendix E. Fifty-one groundwater parameter and monitoring well combinations were evaluated during this period. The data sets collected in this monitoring period were merged with historical data, and the statistical analyses were completed as described in Appendix E.

Statistically significant results were reported for 19 well-parameter data sets across seven wells. Four well-parameter data sets had statistically significant downward trends, and three exhibited upward trends. Twelve data sets across six wells were observed to be outside of trend controls including both indicators (TOC and TOX) and three field parameters (redox, dissolved oxygen, and specific conductance). The values for total predicted organics for each well were plotted on a concentration scaled symbol map (see Figure 9). Plots of TOC, TOX, and total organics versus time for these wells are shown in Figure 12.

Of the seven wells sampled for TOC and TOX as part of this program, five wells exhibit no increasing or decreasing trend, one well shows a decreasing trend and one shows an increasing trend. Therefore, site conditions are generally unchanging. Rising predicted organic concentrations at L14-M01B could possibly be due to the influence of nearby pumping well M14-R02CD as well as the cessation of pumping from H11-R01CD in 2009.

5.1.3 Conclusions and Findings

In summary, the analyses indicate that the majority of the statistical trends are either stable or decreasing. Further, the wells with increasing statistical trends are within the hydraulic containment of the IWS and will continue to be monitored during future sampling events. Therefore, additional evaluation or sampling is not necessary and the existing program is adequate to monitor conditions in groundwater at the A, B and C Basins.

5.2 Chambers Works Perimeter Monitoring Program (PMP)

The Chambers Works PMP monitors groundwater quality around the perimeter of the site by sampling wells located along the Delaware River, Salem Canal, and the eastern boundary. The purpose of this monitoring is to demonstrate control of site groundwater and the on-site containment of site constituents in groundwater.

In accordance with the PMP schedule, all of the 38 PMP wells were sampled during the current reporting period. The PMP wells were sampled for the analytes listed in Table 4, Parts 4 and 5.

5.2.1 Quality Assurance

The electronic data submitted for this program were reviewed via the EIM DVM. Analytical results for the second semester 2018 are reported in Table 6. Results for the equipment blank and trip blanks can be found in Table 12. Evaluation of laboratory control samples confirmed proper laboratory system performance and the matrix effects were relatively minor and did not adversely affect the usability of the results. A more detailed discussion can be found in the QAR (see Appendix D).

5.2.2 Analyses and Discussion

Statistical analyses conducted on the groundwater parameters and wells in the perimeter monitoring program are presented in Appendix E. A total of 417 groundwater parameter and monitoring well combinations was evaluated during this period. The data sets collected in this monitoring period were merged with historical data to initiate the statistical analysis process as described in Appendix E.

Statistically significant results were reported for 138 well-parameter data sets across multiple wells. In total, 114 data sets were observed to be outside of trend controls. Constituents determined to be outside of trend controls include all five field parameters (pH, dissolved oxygen, temperature, redox potential, and specific conductance), both indicators (TOC and TOX), several metals, VOCs, and SVOCs. Data sets outside of trend controls will be monitored during future sampling events. The values for total predicted organics for each well were plotted on a concentration scaled symbol map (see Figures 10 and 11). Plots of TOC, TOX, and total organics versus time for these wells are shown in Figure 13.

5.2.3 Conclusions and Findings

In summary, the analyses indicate that the majority of the statistical trends are either stable or decreasing. Further, the wells with increasing statistical trends are within the hydraulic containment of the IWS and will continue to be monitored during future sampling events. Therefore, additional evaluation or sampling is not necessary, and the existing program is adequate to monitor conditions in groundwater around the perimeter of the site.

5.3 Post-Closure Monitoring for RCRA Units

Four wells are sampled annually for the Post-Closure Monitoring of the RCRA Units Program (as part of the RCRA SWMU post-closure plan for SWMUs 21, 25, 26, and 28). The purpose of this sampling is to ensure that the closure of the RCRA units is protective of human health and the environment and to demonstrate that conditions have not changed that may warrant further evaluation. Two of these four monitoring wells are also sampled as part of the PMP (see Table 4, Parts 4 and 6). The wells that are part of this monitoring program are as follows:

- C08-M01B*
- C09-M01B*
- G14-M01B
- L12-M01B

*These wells are also part of the PMP.

5.3.1 Quality Assurance

The electronic data submitted for this program were reviewed via the EIM DVM. Analytical results for the second semester 2018 are reported in Table 7. Results for the equipment blank and trip blanks can be found in Table 12. Evaluation of laboratory control samples confirmed proper laboratory system performance and that the matrix effects were relatively minor and did not adversely affect the usability of the results. A more detailed discussion can be found in the QAR (see Appendix D).

5.3.2 Analyses and Discussion

Statistical analyses conducted on 141 unique groundwater parameter and monitoring well data sets were evaluated in the Post-Closure Monitoring for RCRA Units monitoring program and are presented in Appendix E. The data sets collected in this monitoring period were merged with historical data to initiate the statistical analysis process as described in Appendix E.

This program had the fewest numbers of NJGWIIA exceedances and included only one metal (lead) and one VOC (1,2-dichloroethane) at one well. The rest of the data sets carried forward from the Tier II screening process were all polychlorinated biphenyl (PCB) congeners. Only one well-parameter data set had a statistically significant downward trend (PCB 42).

5.3.3 Conclusions and Findings

In summary, the groundwater statistics were reviewed, and further evaluation (i.e., sampling) is not necessary based on the majority of the statistical trends being either stable or decreasing. All of the wells with increasing statistical trends are within the hydraulic containment of the IWS and will continue to be monitored during future sampling events.

5.4 PFOA Monitoring Program

The PFOA Monitoring Program monitors 36 wells semi-annually for 16 per- and polyfluoroalkyl substances (PFAS) under EPA method 537 Modified, in compliance with NJPDES-DGW Permit No. NJ0083429. The purpose of the monitoring program is to gather the data necessary to document the nature and extent of PFAS in groundwater on-site. Results of the sampling events are submitted to NJDEP within 90 days of sampling and are also presented in the corresponding semi-annual NJPDES-DGW report.

In accordance with the PFOA Monitoring Program, all 36 wells were sampled for PFAS as listed in Table 4, Part 9 during the current reporting period.

5.4.1 Quality Assurance

The electronic data submitted for this program were reviewed via the EIM DVM. Analytical results for the current reporting period are provided in Tables 6A and 6B and shown in Figure 14. Results for the equipment blank and trip blanks can be found in Table 10. Evaluation of laboratory control samples confirmed proper laboratory system performance and that the matrix effects were relatively minor and did not adversely affect the usability of the results. A more detailed discussion can be found in the QAR (see Appendix D).

5.4.2 Analyses and Discussion

With the exception of C11-M01E and AA25-M01C, PFAS were detected in all 36 wells of the PFOA monitoring program. The highest PFAS detected was Perfluorohexanoic Acid (PFHXA) [830 micrograms per liter (µg/L)] at G09-M01A. G09-M01A is a shallow well located near a former sump that previously received process wastewater. In addition to PFHXA, G09-M01A also has the highest detections of other PFAS such as perfluorononanoic acid (PFNA) at 150 µg/L, perfluoroheptanoic acid (PFHA) at 140 µg/L, and perfluorodecanoic acid (PFDA) at 160 µg/L. In general, PFAS were detected at their highest concentrations in the shallow wells and concentrations decreased with depth.

Statistical analyses conducted on 304 unique groundwater parameters and monitoring well data sets for the PFOA monitoring program are presented in Appendix E. The data sets collected in this monitoring period were merged with historical data to initiate the statistical analysis process as described in Appendix E. Based on those analyses, Perfluorobutane Sulfonic Acid (PFBS) at well C11-M03B shows a decreasing concentration trend and six PFAS had an increasing trend at four wells as shown in the following table.

Well	Analyte Type	Analyte	Units	Current Result (July 2018)	Trend Test Results
C11-M03B	(8) PFCs	PERFLUOROBUTANE SULFONIC ACID	µg/L	0.01	Downward
D06-M01B	(8) PFCs	PERFLUOROOCTANE SULFONIC ACID	µg/L	0.041	Upward
D06-M01B	(8) PFCs	PERFLUORODODECANOIC ACID	µg/L	0.036	Upward
N08-M01C	(8) PFCs	PERFLUOROHEPTANOIC ACID	µg/L	1.8	Upward
N08-M01C	(8) PFCs	PERFLUOROHEXANOIC ACID	µg/L	2.5	Upward
N08-M01D	(8) PFCs	PERFLUOROHEXANOIC ACID	µg/L	2.1	Upward
P06-M01E	(8) PFCs	PERFLUOROBUTANOIC ACID	µg/L	0.12	Upward
P06-M01E	(8) PFCs	PERFLUOROPENTANOIC ACID	µg/L	0.099	Upward

Only PFNA has a NJGWIIA standard for comparison. PFNA exceeded NJGWIIA at each well location except for AA25-M01C and the four wells constructed in the E (deepest) aquifer. Monitoring wells AA25-M01C, C11-M01E, G04-M01E, and R10-M01E had no detections of PFNA, where P06-M01E had a detection of 0.0024 µg/L, which is below the NJGWIIA standard of 0.01 µg/L.

5.4.3 Conclusions and Findings

PFAS is detected in on-site groundwater, and PFNA has been detected at concentrations exceeding NJGWIIA, In general, PFAS concentrations were highest near process buildings in which they were used and decrease with depth and distance. The presence and extent of these compounds are further discussed in the Conceptual Site Model (CSM) for Poly- and Perfluoroalkyl Substances (AECOM, July 2017).

5.5 Secure C Landfill Corrective Action Groundwater Monitoring Program

The corrective action monitoring program for Area 1 of the Secure C Landfill monitors groundwater quality in the following five wells in compliance with NJPDES-DGW Permit No. NJ0083429:

- P21-M01B
- P21-M04B
- Q20-R01B (recovery well)
- Q21-M01B
- P21-R01B (recovery well)
- S24-M01B*
- T22-M01B*

* Background wells

All five wells and the background wells are monitored semi-annually for Secure C Landfill Corrective Action (CLF-CA) target analytes (see Table 4, Part 3). The purpose of this sampling is to monitor groundwater quality to ensure that the groundwater collection system in place is protective of human health and the environment and that conditions have not changed that may reduce the effectiveness of this remediation system.

5.5.1 Quality Assurance

The electronic data submitted for this program were reviewed via the EIM DVM. Analytical results for the current reporting period are provided in Table 9; background wells S24-M01B and T22-M01B are shown in Table 11. Results for the equipment blank and trip blanks can be found in Table 12. Evaluation of laboratory control samples confirmed that proper laboratory system performance was achieved. A more detailed discussion can be found in the QAR (see Appendix D).

5.5.2 Statistical Analyses and Analyte Discussion

Statistical analyses were conducted on 60 groundwater parameters analyzed in samples collected from each of the five monitoring wells in the CLF-CA program. Statistical analyses are not required in background wells, S24-M01B and T22-M01B. The results are presented in Appendix E.

To initiate the statistical analyses, data sets from the current monitoring period were merged with historical data. Of the 60 groundwater parameters analyzed, statistically significant results were identified in 25 monitoring well data sets. Of the 25 significant results, 12 statistically increasing trends were identified, and three decreasing trends were identified. The remaining 10 well data sets showed no increasing or decreasing trend. Analytical results for organics were summed for the five CLF-CA monitoring wells (see Table 9) and the two background wells (see Table 11). Total organic concentrations for each CLF-CA well are plotted on a concentration scaled symbol map (see Figure 9).

In summary, the groundwater statistics showed that there are increasing and decreasing trends within the data sets. However, all the wells with increasing statistical trends are within the capture zone of the recovery wells.

5.5.3 Conclusions and Findings

The Corrective Action system for the Secure C Landfill, which is comprised of recovery wells P21-R01B and Q20-R01B, was designed to control groundwater flow from Area 1 of the Secure C Landfill. The current and previous groundwater investigations have continued to confirm the effectiveness of this system in achieving this remedial goal. During the current reporting period, the system had an average recovery rate of 6.54 gpm. This system continues to effectively control groundwater at the Secure C Landfill, and all statistically significant increasing trends are within the extent of hydraulic containment.

5.6 Secure C Landfill Detection Monitoring Program

The detection monitoring program for the Secure C Landfill monitors the following four wells near Areas 2, 3, 4, 5A, 5B, and 7 of the Secure C Landfill and two background wells in compliance with NJPDES-DGW Permit No. NJ0105872:

- R19-M01B
- R19-M02B
- S19-M01B
- S19-M02B
- S24-M01B*
- T22-M01B*

* Background wells

The four wells and two background wells (S24-M01B and T22-M01B) are monitored semi-annually for Secure C Landfill Detection Monitoring (CLF-DM) target analytes (see Table 4, Part 7). This list of target analytes is based on leachate characterization data from Areas 2, 3, 4, 5A, and 5B of the Secure C Landfill. The purpose of this detection monitoring program is to continue to demonstrate that the landfill leachate collection system is operating effectively.

5.6.1 Quality Assurance

The electronic data submitted for this program were reviewed via the EIM DVM. Data results for the current reporting period are provided in Table 10; background wells S24-M01B and T22-M01B are shown in Table 11. Results for the equipment blank and trip blanks can be found in Table 12. Evaluation of laboratory control samples confirmed proper laboratory system performance and that the matrix effects were relatively minor and did not adversely affect the usability of the results. A more detailed discussion can be found in the QAR (see Appendix D).

5.6.2 Statistical Analyses and Analyte Discussion

To perform the statistical analyses, the groundwater parameters analyzed in the four CLF-DM wells were merged with historical data as described in Appendix E. Statistical analyses are not required in background wells, S24-M01B and T22-M01B. Thirty-two parameter data sets were statistically tested. Statistically significant results were identified in five data sets. Of these five, three data sets exhibited statistically significant upward trends (sodium, specific conductance, and TOC), and one exhibited a decreasing trend (dissolved oxygen).

5.6.3 Conclusions and Findings

In summary, the groundwater statistics indicate that the majority of trends are either stable or decreasing. All the wells with increasing statistical trends are within the capture zone of the recovery wells. These findings in conjunction with the groundwater elevation data presented in Figure 5 indicate that leachate detection system is effectively monitoring groundwater quality for the potential release of constituents from the landfill and those that are detected are within the hydraulic containment of the recovery wells.

5.7 Leachate Collection System Monitoring Program

The purpose of the LCS Monitoring Program is to characterize the landfill leachate to provide a list of primary constituents specific to the Secure C Landfill Areas 2, 3, 4, 5A, 5B, and 7. This list of primary constituents will be used to refine the CLF-DM target analyte list (see Section 5.6). The leachate generated by the landfill is sampled at the following ports in the LCS:

- Sample Port 274 (Areas 2 and 3)
- Sample Port 276 (Area 4)
- Sample Port 5A (Area 5A)
- Sample Port 5B (Area 5B)
- Sample Port 7 (Area 7)

Sample ports 274, 276, Sump 5A, Sump 5B, and Sump 7 are sampled biennially for indicator parameters, VOCs, SVOCs, and inorganics (see Table 4, Parts 7 and 8). Sampling the leachate confirms or updates the list of primary constituents (see Table 4, Part 8). Sampling was not conducted during this semester, and the next sampling event for Areas 2, 3, 4, 5A, 5B, and 7 will be in January 2019.

6.0 Ongoing Remedial Action Development Activities

The purpose of this section is to provide a status update of ongoing remedial action development activities.

6.1 Well Status Update

No monitoring wells were installed during the current reporting period.

As discussed in a February 14, 2018 meeting with the EPA and NJDEP, an updated work plan that details the construction and sampling of 19 off-site and one on-site groundwater monitoring wells at eight locations surrounding the Chambers Works Complex has been prepared and submitted to NJDEP. The purpose of these wells is to investigate the nature, extent, and changes of PFAS detections in groundwater in areas of known presence using secured and returnable monitoring stations. These wells will be installed beginning in June 2019.

6.2 Perimeter Remedial Action

The perimeter investigation identified and characterized three groundwater plumes in the B aquifer that migrate from the perimeter areas of AOCs 1, 2, and 3 to the Delaware River as a result of the incomplete B aquifer capture by the IWS as documented in the *Perimeter Investigation Report* (URS, August 2010). For these areas, a remedial alternatives evaluation was conducted, and a steel SPB to control groundwater from discharging to surface water was selected as an appropriate remedy.

Preliminary design and field investigation activities for the extension of the Salem Canal SPB westward and then northward along the Delaware River to the northern end of AOC 1 were completed in 2014. The installation of the AOCs 2 and 3 sections of the SPB were completed in 2015. Installation of the final AOC 1 section of the SPB was completed in December 2017. Based on water-level data, the SPB is effectively controlling groundwater discharge. Additional investigation based on tidal studies is ongoing to collect the data necessary to more thoroughly evaluate the performance of the SPB. These results will be presented in upcoming NJPDES-DGW reports.

6.3 Interior Investigation Activities/Comprehensive RFI Report

The *Comprehensive RCRA Facility Investigation Report* (URS, October 2014) was submitted to EPA and NJDEP in October 2014. The report summarized the nature and extent of constituents released from regulated units, SWMUs, and other source areas at the facility, supported the development of a Corrective Measures Study (CMS), supported recommendations of No Further Action (NFA) or CMS for SWMUs and AOCs, and completed the requirements of the RFI phase for the site.

Chemours received and reviewed the comment letter from the EPA (dated March 23, 2018, received on April 13, 2018), which included NJDEP comment letters, on the following Chemours Chambers Works RFI documents:

- Comprehensive RCRA Facility Investigation Report (October 2014) (referred to as RFI report)
- Appendix A: Fact Sheets for Areas of Concern (AOCs) and Solid Waste Management Units (SWMUs) (September 2014) (referred to as the Fact Sheets)

- 2014 Comprehensive RFI Supplemental Information Soil Data Post Maps (September 2015)
- 2014 Comprehensive RFI Supplemental Information SWMU Documentation (April 2016)

Chemours met with EPA and NJDEP in a routine quarterly status meeting on April 25, 2018. The receipt date for the comment letter was discussed. Based on this meeting, comments to the RFI were prepared and submitted to EPA in a letter dated May 11, 2018.

6.4 Salem Canal Remedial Action

6.4.1 Groundwater

An SPB was installed in December 2008 along the northern bank of the canal as an Interim Remedial Action (IRA) to prevent the migration of impacted groundwater into and underneath the canal. The effectiveness of the SPB was evaluated with water-level data collected over a three-year period after installation. Analyses indicated that the SPB is achieving its design purpose to redirect groundwater flow and prevent impacted groundwater migration to the canal surface water and sediment and downgradient groundwater. The detailed analyses and conclusions are summarized in the *Salem Canal Groundwater Remedial Action Progress and Sediment Investigation Status Report* (URS, 2013).

Based on agency review comments and follow-on discussion in late 2014, additional groundwater monitoring to support evaluation of the SPB was proposed in the *Supplemental Groundwater Monitoring Work Plan for Salem Canal Sheet-Pile Barrier* (submitted on December 19, 2014). The work plan was approved by the EPA on July 10, 2015, and the work began in September 2015. As part of this investigation, seven monitoring wells (F05-M03B, F05-M04B, F05-M05B, G05-M08B, H05-M03B, H05-M04B, and I05-M03B) were installed to better characterize groundwater flow and quality in the vicinity of the SPB. Six wells were installed as pairs (either with a new well or with an existing well) to monitor the B aquifer at upgradient and downgradient locations across the SPB. The seventh well, F05-M03B, was installed southwest of Salem Canal to document groundwater quality near the southwestern edge of the Chambers Works perimeter. Groundwater elevations and groundwater samples are collected on a semi-annual basis from these wells and other wells in the area to provide the data necessary to demonstrate the effectiveness of the SPB at controlling groundwater. Results of these semi-annual investigations are reported in the corresponding semi-annual NJPDES-DGW report. A summary report that includes a synthesis of data will be created following the last (eighth) sampling event as documented in the *Supplemental Groundwater Monitoring Work Plan for Salem Canal Sheet Pile Barrier* (AECOM, 2014).

A synoptic round of water levels was collected on March 21, 2019 from 30 wells. The purpose of these data is to provide a snapshot picture of groundwater elevation in the area of the SPB. In addition, to better understand changes to water quality over time, 16 monitoring wells were sampled in the winter of 2019. The results of these semi-annual investigations are provided in the semi-annual update report for the supplemental groundwater investigation (see Appendix G).

6.4.2 Sediment and Surface Water

As requested by the EPA and NJDEP (EPA letter dated October 2, 2014), a canal-wide sediment and surface-water characterization investigation was conducted in 2016 in accordance with the Salem Canal Characterization Sampling Plan (Canal-Wide SAP; AECO,M 2016). The results of these investigations were completed and summarized in the 2017 Salem Canal Investigation Summary report (AECOM, 2017), which was submitted to NJDEP and EPA in February 21, 2017. EPA and NJDEP provided comments on the 2017 report on September 14, 2017. Reponses to these comments were prepared and submitted on December 7, 2017.

As requested by EPA in a letter dated November 18, 2014, a Revised Salem Canal Screening Level Ecological Risk Assessment (Revised SLERA) was conducted in accordance with EPA Ecological Risk Assessment Guidance for Superfund (ERAGS). This document provided a revision of the SLERA submitted to the EPA and NJDEP in January 2015. The Revised SLERA incorporates surface water, bulk sediment, and pore water data collected since the 2015 SLERA, including data collected in 2016 as well as NJDEP and EPA comments on the 2015 SLERA. The Revised SLERA was submitted on April 12, 2017. EPA and NJDEP comments to the Revised SLERA were received on November 28, 2017, in a letter dated November 24, 2017. The response to these comments were prepared and submitted to EPA on January 26, 2018.

As discussed in the Salem Canal investigation report and Revised SLERA response to comments, additional investigations are planned to collect information necessary to address those comments. These investigations were conducted in the second semester of 2018, and the findings will be used to further revise the SLERA in the first half of 2019.

6.5 E Aquifer Control Well J05-W01E

The hydraulic control of J05-W01E will be further evaluated as per the agreement to install new E aquifer monitoring wells as discussed in Section 3.5.

6.6 T29 Area

The T29 Area is a groundwater evaluation at a former laboratory waste disposal pit in Carneys Point. This area had been previously investigated and had shown no risk to ecological receptors in Bouttown Creek. Monitoring well T29-M02B was installed on February 12, 2015, developed, and subsequently sampled on March 26, 2015. Due to elevated levels of constituents in the groundwater, a second round of confirmatory sampling was performed in September 2015. Results show that although concentrations decreased from the first to second round of sampling, constituents are still in exceedance of NJGWIIA.

T29-M02B was sampled for PCBs, VOCs, and SVOCs in January 2018. In addition, one round of sampling for these same parameters was completed at surface-water stations within Bouttown Creek and Henby Creek. The purpose of this sampling is to satisfy a request from the Delaware River Basin Commission (DRBC) for additional information regarding PCBs that were previously detected at well T29-M02B. Results from these sampling events were submitted to the DRBC on March 19, 2018 in the PCB Pollutant Minimization Plan Report. Results from the January 2018 sampling event were included in the first semester 2018 DGW report. T29-M02B will be sampled again in the first half of 2019.

6.7 Off-Site Monitoring for Perfluorinated Compounds

As discussed in a February 14, 2018 meeting with the EPA and NJDEP, Chemours agreed to install and sample 19 off-site and one on-site groundwater monitoring wells at eight locations surrounding the Chemours Chambers Works Complex. This work is being undertaken to further investigate the horizontal and vertical delineation of per and poly-fluorinated alkyl substances (PFAS) in off-site groundwater as discussed at quarterly meetings between Chemours, NJDEP, and the EPA.

The purpose of the off-site wells will be to investigate the nature, extent, and changes of PFAS detections in groundwater in areas of known presence using secured and returnable monitoring stations. Both groundwater elevation measurements and groundwater sampling data from shallow, intermediate, and deep intervals will be collected at each location. Initial results of this sampling and groundwater elevation monitoring program along with recommendations for future sampling in terms of sampling interval and parameter list will be submitted with the semi-annual NJPDES-DGW Report. A technical memorandum that will summarize the results of well construction program, lithologic logs, and sampling results will be prepared and integrated into the site Conceptual Site Model for PFAS as part of the 2019 update.

7.0 Recommendations

Based on the findings of this semester and as per requests provided by NJDEP in the February 14, 2018 meeting, the following additions and changes are recommended for the NJPDES-DGW program starting 1H19:

- Two shallow B aquifer wells (AA25-M02B and Z28-M02B) were installed and sampled to monitor groundwater along the northeastern property boundary. Results show elevated detections of five metals that slightly exceed NJGWIIA standards. PCE was detected at the NJGWIIA standard. These wells will continue to be sampled, and the results of sampling will be used as a basis for recommendations for additional monitoring, if needed.
- Two shallow B aquifer wells (P22-M01B and O21-M01B) were installed and sampled to monitor groundwater quality and the effectiveness of the Corrective Action wells in the area between the Delaware River and the western side of the Secure C Landfill. Six metals that slightly exceed NJGWIIA standards were detected. Based on high chloride and sodium detections, groundwater from these wells are believed to show the influence of high total dissolved solids surface water recharging the shallow aquifer. These wells will continue to be sampled, and the results of sampling will be used as a basis for recommendations for additional monitoring, if needed.
- Although not a program under the NJPDES-DGW program, two rounds of sampling for PCBs, VOCs, and SVOCs were undertaken at well T29-M02B. In addition, one round of sampling for these same parameters was also undertaken at surface-water stations within Bouttown Creek and Henby Creek. The purpose of this sampling is to satisfy a request from the DRBC for additional information regarding PCBs that were previously detected at well T29-M02B. The results were submitted to the DRBC on March 19, 2018 in the PCB Pollutant Minimization Plan Report. The next sampling event for T29-M02B is scheduled for the spring of 2019.
- An updated work plan that details the construction and sampling of 19 off-site and one on-site groundwater monitoring wells at eight locations surrounding the Chambers Works Complex was submitted to NJDEP in the fall of 2019. The purpose of the off-site wells will be to investigate the nature, extent, and changes of PFAS detections in groundwater in areas of known presence using secured and returnable monitoring stations. These wells will be installed beginning in June 2019.

8.0 References

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Tables

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Table 1
Groundwater Recovery Program - Monthly and Instantaneous Flow Rates
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Monthly Flow (volumes reported in millions of gallons)

	Interceptor Well System								E Aquifer Pumping Well		C- Landfill Corrective Action Wells (CLCAW)			
Well ID	Q13-R01C	Q13-R01D	R09-R02C	M14-R02CD	G08-R01C	G08-R01D	K06-R02CD		J05-W01E		Q20-M02B	P21-R01B		
Month								Total (IWS)		Total (E Aquifer)			Total (CLCAW)	Total Gallons
July	0.00	0.00	0.00	17.54	2.75	3.76	10.12	**34.18**		**10.69**	0.00	0.24	**0.24**	**45.10**
August	0.00	0.00	0.00	17.02	2.65	3.26	10.13	**33.06**		**10.68**	0.00	0.02	**0.02**	**43.76**
September	0.00	0.00	0.00	16.30	2.36	4.50	9.28	**32.44**		**10.31**	0.13	0.38	**0.51**	**43.27**
October	0.00	0.00	3.07	16.96	2.52	2.23	8.65	**33.44**		**10.56**	0.01	0.17	**0.18**	**44.18**
November	0.00	0.00	20.05	13.11	1.78	0.68	1.44	**37.05**		**10.13**	0.00	0.44	**0.44**	**47.63**
December	0.00	0.00	12.87	7.87	1.29	1.83	9.36	**33.21**		**10.56**	0.00	0.46	**0.46**	**44.23**
Well Totals	**0.00**	**0.00**	**35.99**	**88.81**	**13.35**	**16.26**	**48.98**				**0.142**	**1.706**		
Program Totals								**203.39**		**62.93**			**1.85**	**268.16**

Instantaneous Flow Measurements (volumes reported in gallons per minute)

	Interceptor Well System							E Aquifer Pumping Well	C- Landfill Corrective Action Wells (CLCAW)	
Well ID	Q13-R01C	Q13-R01D	R09-R02C	M14-R02CD	G08-R01C	G08-R01D	K06-R02CD	J05-W01E	Q20-M02B	P21-R01B
Month										
Oct 23	0	0	0	400	80	0	200	210	0	10

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Table 2A
Secure C Landfill Leachate Collection System
and Leak Detector System Flow Data
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Monthly Flow Volume (gallons)

Month	Leachate Collection Sump 2 (Areas 2 & 3)	Leachate Collection Sump 3 (Area 4)	Leachate Collection Sump 5A (Area 5A)	Leachate Collection Sump 5B (Area 5B)	Leachate Collection Sump 7 (Area7)	Leak Detection Area 2	Leak Detection Area 3	Leak Detection Area 4	Leak Detection Area 5A	Leak Detection Area 5B	Leak Detection Area 7
July	95,373	140,244	235,500	359,828	126,582	30	21	263	895	0	0
August	183,324	46,269	241,340	663,552	81,856	30	28	167	1,067	183	0
September	204,948	40,507	236,800	472,405	181,000	284	298	212	39	183	0
October	159,553	126,348	259,810	336,332	132,599	116	166	361	6,773	244	147
November	143,375	17,818	247,130	2,500	169,872	1,065	757	67	1,172	0	0
December	156,614	21,062	251,100	10,463	335,266	712	431	27	5	122	294
Totals	**943,187**	**392,248**	**1,471,680**	**1,845,080**	**1,027,175**	**2,237**	**1,701**	**1,097**	**9,951**	**732**	**441**

Notes:
Not all counters are working properly.

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Table 2B
Secure C Landfill Leak Detector System
Action Leak Rate (ALR) Totals
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Leak Detection Flow Rate (gallons per acre per day)

Week Ending	Area 2 Subcells		Area 3 Subcells		Area 4 Subcells				Area 5 Subcells		Area 7	Rain (in)
	2-1	2-2	3-1	3-2	4-1	4-2	4-3	4-4	5A	5B	7	
7/7/2018	0	-2	0	0	-1	-3	10.38	0	-108	0	0	0.11
7/14/2018	0	0	0	0	0	1	3.46	0	30	0	0	0.00
7/21/2018	0	0	0	0	0	1	0.00	0	3	0	0	0.25
7/28/2018	0	0	0	0	0	1	0.00	3	0	0	0	2.84
8/4/2018	0	-1	0	0	0	-2	-114.21	0	2	0	0	0.54
8/11/2018	0	0	0	0	1	1	0.00	0	8	-9,770	0	0.37
8/18/2018	0	0	0	1	0	1	0.00	6	6	0	0	2.32
8/25/2018	0	0	0	0	0	1	0.00	0	7	0	0	0.46
9/1/2018	0	-1	-1	-1	-1	-2	0.00	0	37	0	0	0.12
9/8/2018	0	0	0	1	0	1	3.46	0	-1	0	0	1.00
9/15/2018	8	8	6	8	0	0	0.00	0	1	3	0	3.12
9/22/2018	0	0	0	0	1	3	0.00	0	1	0	0	0.29
9/29/2018	0	0	0	0	0	1	0.00	0	1	7	0	2.23
10/6/2018	0	0	0	0	0	1	0.00	0	19	0	7	0.33
10/13/2018	4	2	2	5	0	1	17.30	6	89	0	0	1.95
10/20/2018	0	0	0	0	0	1	0.00	0	117	10	0	0.27
10/27/2018	0	0	0	0	1	0	0.00	0	-194	3	0	1.51
11/3/2018	0	0	0	0	0	1	0.00	0	146	0	0	1.65
11/10/2018	0	1	0	0	0	1	0.00	0	17	0	0	2.80
11/17/2018	14	8	6	7	0	1	3.46	0	-1	0	0	2.12
11/24/2018	10	9	7	6	0	1	0	0	1	0	0	0.05
12/1/2018	11	9	7	8	0	0	0	0	0	3	15	2.5
12/8/2018	9	7	8	5	0	1	0	0	0	0	-15	0.78
12/15/2018	0	1	0	0	0	1	0	0	0	3	0	0.35
12/22/2018	9	6	4	7	0	0	0	0	0	0	0	3.09
12/29/2018	8	1	0	0	0	1	0	0	0	0	0	1.59

Notes: *LD-5A had instrumentation/equipment problems.

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Table 3
Summary of DNAPL Recovery Volume
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Well ID	Start Date for Removal	System for Removal	2H18 Semester Amount Removed (gallons)	Total Volume Removed (gallons)	Notes
L13-M01B	03/2001	Pump	0	3393	Checked with bailer monthly, System off due to no DNAPL accumulation
G05-M03B	07/2003	Pump	55	1720.67	System operated entire 2H18.
G05-M02B	2010	Bailer	0	51.8	Was pumped from 2010-2013 but no longer productive.
J12-M01B	2002	Bailer	0	40.179	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
J12-M02B	01/2004	Bailer	0.050	2.141	
G06-M03B	2005	Bailer	0.290	12.393	
G06-M04B	2005	Bailer	0.38	6.476	
I12-M02B	2001	Bailer	0	7.68	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
M12-M02B	2004	Bailer	0	0.06	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
D15-M01C	2009	Bailer	0	0.253	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
H11-R01CD	2010	Bailer	0.320	6.651	
K11-M01B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
L12-M03B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
L13-M02B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
J10-M02B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
M12-M04B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
G06-M02B	--	Bailer	0	0	Checked for DNAPL monthly, but no DNAPL was recovered for 2H18
D15-P08B	2014	Bailer	20	167	
F09-M03B	2014	ISCOPump	41	280.5	
F10-P01B	2015	ISCOPump	40	253.3	

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Table 4
Chambers Works Groundwater Monitoring Schedule
Part 1: Corrective Action Monitoring Program - Basins Post Closure
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

	Sampling Event:	Jul 2018		Jan 2019		Jul 2019		Jan 2020		Jul 2020		Jan 2021		Jul 2021		Jan 2022		Jul 2022		Jan 2023		Jul 2023		Jan 2024	
	Sampling Parameters:	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin	IND1	Basin
Closure and Post Closure for the A, B, & C Basins (7)	G16-M02B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	H13-M02B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	H14-M01B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	H16-P01B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	K13-M02B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	J16-M01B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--
	L14-M01B	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--	SA	TRiE	SA	--	SA	--	SA	--	SA	--	SA	--

Notes:

Frequency

SA = Semiannually
Ann = Annually
TRiE = Triennially (every three years)
-- not required

Analyte Lists (attached)

IND1 = indicator parameters (as defined in Table 4, Part 2)
Basin = Basin Closure Monitoring Program Analyte List (as defined in Table 4, Part 2)

Table 4
Chambers Works Groundwater Monitoring Schedule
Part 3: Corrective Action Monitoring at the Secure C Landfill
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Sampling Parameters:		**Frequency (IND1 & CLF-CA)**
Monitoring Program for Corrective Action at the Secure C Landfill (5 plus 2 background wells)	P21-M01B	SA
	P21-M04B	SA
	P21-R01B	SA
	Q20-M02B	SA
	Q21-M01B	SA
	S24-M01B*	SA
	T22-M01B*	SA

***Background wells for Corrective Action and Detection Monitoring Programs at the Secure C Landfill**
SA=Semiannually

IND1 Analyte List			
Indicator Parameters	**Field Parameters**		
TOC	Temperature	Dissolved oxygen	
TOX	Specific conductivity	Eh	
	pH		
CLF-CA Analyte List			
Indicator Parameters	**Volatiles**	**Semivolatiles**	**Inorganics**
pH (field parameter)	1,1,2-Trichlorotrifluoroethane	1,2-dichlorobenzene	aluminum (total)
Eh (field parameter)	1,4-Dioxane	1,2,4-trichlorobenzene	ammonia
Specific Conduct (field)	benzene	1,4-dichlorobenzene	arsenic (total)
Temp (field parameter)	chlorobenzene	4-chloroaniline	chloride
TOC	chloroform	aniline	cyanide (total)
TOX	methylene chloride	n-nitrosodimethylamine	lead (total)
Total Phenolics	toluene	naphthalene	nitrate as nitrogen
DO (field)	trichloroethylene	o-toluidine	sodium
			sulfate

AECOM

Table 4
Chambers Works Groundwater Monitoring Schedule
Part 5: Perimeter Monitoring Program Analytes
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Chambers Works Perimeter Monitoring Program Analyte List			
Priority Pollutant Volatile Organics	**Priority Pollutant Semivolatile Organics**		**Additional Parameters (2)**
Benzene	***Base Neutral Extractable***	Di-n-octyl phthalate	Aniline
Bromodichloromethane	Acenaphthylene	Fluoranthene	4-Chloroaniline
Bromoform	Acenaphthene	Fluorene	1-Naphthylamine
Bromomethane	Anthracene	Hexachlorobenzene	2-Naphthylamine
Carbon tetrachloride	Benzidine	Hexachlorobutadiene	o-Toluidine
Chlorobenzene	Benzo(a) anthracene	Hexachlorocyclopentadiene	Trichlorofluoromethane
Chloroethane	Benzo(b) fluoranthene	Hexachloroethane	Xylene
Chloroform	Benzo(k) fluoranthene	Indeno(1,2,3-c,d)pyrene	Dissolved lead
Chloromethane	Benzo(ghi) perylene	Isophorone	Organic Lead
Dibromochloromethane	Benzo(a) pyrene	Naphthalene	**Priority Pollutant Total Metals:**
1,1-Dichloroethane	bis(2-Chloroethoxy) methane	Nitrobenzene	Aluminum (3)
1,2-Dichloroethane	bis(2-Chloroethyl) ether	Nitrosodimethylamine	Antimony (3)
1,1-Dichloroethene	bis(2-Chloroisopropyl) ether	N-Nitroso-diphenyl amine	Arsenic(3)
trans-1,2-Dichloroethene	bis(2-Ethylhexyl) phthalate	N-Nitroso-di-n-propylamine	Beryllium(3)
1,2-Dichloropropane	4-Bromophenyl phenyl ether	Phenanthrene	Cadmium(3)
cis-1,3-Dichloropropene	Butyl benzyl phthalate	Pyrene	Chromium (3)
trans-1,3-Dichloropropene	2-Chloronaphthalene	1,2,4-Trichlorobenzene	Iron(3)
1,4-Dioxane	4-Chlorophenyl phenyl ether	***Acid Extractable(1)***	Lead(3)
Ethylbenzene	Chrysene	4-chloro-3-methylphenol	Nickel(3)
Methylene chloride	Di-n-butylphthalate	2-Chlorophenol	Sodium(3)
1,1,2,2-Tetrachloroethane	Dibenzo (a,h) anthracene	2,4-Dichlorophenol	Cyanide (4)
Tetrachloroethene	1,2-Dichlorobenzene	2,4-Dimethylphenol	Mercury (4)
Toluene	1,3-Dichlorobenzene	4,6-Dinitro-2-methylphenol	Selenium (4)
1,1,1-Trichloroethane	1,4-Dichlorobenzene	2,4-Dinitrophenol	Silver (4)
1,1,2-Trichloroethane	3,3-Dichlorobenzidine	2-Nitrophenol	Thallium (4)
Trichloroethylene	Diethyl phthalate	4-Nitrophenol	Zinc (4)
1,1,2-Trichlorotrifluoroethane	Dimethyl phthalate	Phenol	
Vinyl chloride	1,2-Diphenylhydrazine	Pentachlorophenol	
	2,4-Dinitrotoluene	2,4,6-Trichlorophenol	
	2,6-Dinitrotoluene		
IND1 Analyte List			
Indicator Parameters	**Field Parameters**		
TOC	Temperature	Dissolved oxygen	
TOX	Specific conductivity	Eh	
	pH		

(1) Acid extractable semivolatile organics sampling required for B Aquifer CWS only.
(2) Additional parameters for B aquifer CWW and CWS only
(3) Total metals for B aquifer CWW, CWS, and CPW
(4) Total metals for B aquifer CPW only

Table 4
Chambers Works Groundwater Monitoring Schedule
Part 7: Secure C Landfill Detection Monitoring Programs
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Sampling Parameters:		CLF-DM	Sampling Parameters	Sampling Port No.	LCS
Detection Monitoring for Areas 2, 3, 4, 5, and 7 of the Secure C Landfill (4 wells plus 2 background wells)	***T22-M01B**	SA	**Leachate Collection System Monitoring Program at the Secure C Landfill (5 Sampling Ports)**	274	BiE
	R19-M01B	SA		276	BiE
	R19-M02B	SA		Sump 5A	BiE
	S19-M01B	SA		Sump 5B	BiE
	S19-M02B	SA		Sump 7	BiE
	***S24-M01B**	SA			

Frequency
SA = Semiannually
BiE = Biennially (every two years) - Next sampling for LCS will be in January 2021

Analyte Lists (Attached)
LCS = Leachate collection system, analyte list (as defined in Table 4, Part 8)
CLF-DM = Secure C Landfill-Detection Monitoring target analytes (as defined in Table 4, Part 8)

Notes
* Background wells for Corrective Action and Detection Monitoring Programs at the Secure C Landfill

Table 4
Chambers Works Groundwater Monitoring Schedule
Part 9: PFOA Monitoring Program
Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Sampling Parameters:	Well ID	Area Section	Aquifer	Frequency	Analytical	Rationale for Sampling
PFOA Monitoring Program (36 wells)	F08-M01A	Interior	A	SA	PFAS	South of Zonyl Intermediates
	G09-M01A	Interior	A	SA	PFAS	Zonyl Intermediates
	K12-M01A	Interior	A	SA	PFAS	Perfluoroelastomers/fluoroelastomers area
	C08-M01B	CWW	B	SA	PFAS	Jackson Labs area
	C11-M03B	CWW	B	SA	PFAS	Former Antiknocks area
	D06-M01B	CWW	B	SA	PFAS	Jackson Labs area
	D15-M01B	CWW	B	SA	PFAS	Fluoroproducts area
	F07-M01B	Interior	B	SA	PFAS	Spatial distribution
	F08-M01B	Interior	B	SA	PFAS	South of Zonyl Intermediates
	G05-M02B	CWS	B	SA	PFAS	Salem Canal Seep area
	J10-M02B	Interior	B	SA	PFAS	Spatial distribution
	K13-M02B	Interior	B	SA	PFAS	South of A, B, and C Basins
	L09-M01B	Interior	B	SA	PFAS	Western edge of SWMU 8
	N08-M01B	Interior	B	SA	PFAS	South of SWMU 8
	P06-M01B	CWE	B	SA	PFAS	Eastern perimeter well
	P21-M01B	Interior	B	SA	PFAS	Area 1 of C-Landfill
	R09-M02B	Interior	B	SA	PFAS	Eastern edge of SWMU 8
	AA25-M01B(C)	CPE	C	SA	PFAS	Eastern perimeter well
	C11-M01C	CWW	C	SA	PFAS	Former Antiknocks area
	G04-M01B(C)	CWS	C	SA	PFAS	Southern perimeter well
	L09-M01C	Interior	C	SA	PFAS	Western edge of SWMU 8
	N08-M01C	Interior	C	SA	PFAS	South of SWMU 8
	P06-M02C	CWE	C	SA	PFAS	Eastern perimeter well
	R10-M01C	Interior	C	SA	PFAS	Eastern edge of SWMU 8
	Z28-M01B(C)	CPE	C	SA	PFAS	Eastern perimeter well
	AA22-M01B(D)	CPE	D	SA	PFAS	Eastern perimeter well
	AA25-M01C(D)	CPE	D	SA	PFAS	Eastern perimeter well
	C11-M02D	CWW	D	SA	PFAS	Former Antiknocks area
	J05-M01C(D)	CWS	D	SA	PFAS	White Products area
	L09-M01D	Interior	D	SA	PFAS	Western edge of SWMU 8
	N08-M01D	Interior	D	SA	PFAS	South of SWMU 8
	P06-M01D	CWE	D	SA	PFAS	Eastern perimeter well
	C11-M01E	CWW	E	SA	PFAS	Former Antiknocks area
	G04-M01E	CWS	E	SA	PFAS	Southern perimeter well
	P06-M01E	CWE	E	SA	PFAS	Eastern perimeter well
	R10-M01E	Interior	E	SA	PFAS	Eastern edge of SWMU 8

PFAS = Per- and Polyfluoroalkyl Substances

FREQUENCY

SA = Semi-Annually (two times per year)

AREA SECTIONS

CWW = Chambers Works Western Perimeter along Delaware River
CWS = Chambers Works Southern Perimeter along Salem Canal
CWE = Chambers Works Eastern Perimeter along Route 130
CPW = Carneys Point Western Perimeter along Delaware River
CPE = Carneys Point Eastern Perimeter along Route 130
Interior = Interior of complex

AECOM

Table 5
Summary of Analytical Results
Closure and Post-Closure for A, B, and C Basins Second Semester 2018
Chambers Works Complex
Deepwater, New Jersey

Analyte	Units	Location Sample Date Sample Type	G16-M02B 07/09/2018 FS	H13-M02B 07/09/2018 FS	H14-M01B 07/09/2018 FS	H16-P01B 07/09/2018 FS	J16-M01B 07/09/2018 FS	K13-M02B 07/09/2018 FS	K13-M02B 07/09/2018 DUP	L14-M01B 07/09/2018 FS
Total Organics	mg/L		2.694 P	6.829 P	7.967 P	13.071 P	0.354 P	10.218 P	--	39.530 P
Organic Carbon, total - avg	ug/L		20000	12000	38000	41000	3200	13000	13000	170000
Total Organic Halogen	ug/L		2000 B	<1500	3000 B	3700 B	4600 B	2600 B	1600 B	20000 B
Color	None	--	YES	NONE	NONE	YES	NONE	YES	--	NONE
Dissolved Oxygen	mg/L	--	0.42	0.12	0.37	0.14	0.09	0.29	--	0.09
Odor	None	--	YES	NONE	YES	YES	NONE	YES	--	YES
pH	STD Units	--	5.65	6.65	6.44	5.67	7.18	6.33	--	7.05
Redox	mv	--	43.7	-92.7	-50.3	9.7	-162.9	-40.9	--	-137.1
Specific Conductance	umhos/cm	--	3.073	2.172	6.997	1.833	1.784	1.094	--	1.447
Temperature	Degrees C	--	12	13.01	12.43	12.5	12.33	12.4	--	12.9
Turbidity Quantitative	NTU	--	31.2	17.7	60	94.9	6.51	3.85	--	30

Notes:
B = Comparable detection in lab or field blank
J = Analyte present. Reported value may not be accurate or precise.
P = Predicted Result
-- = Not Analyzed or Not Requested for this event
< = Not detected at the stated reporting limit.
FS = Field Sample
DUP = Duplicate Sample

Appendix A

Chronology of Monitoring Programs

Chronology of Monitoring Programs

Well Nomenclature

The Chemours Chambers Works Complex initiated a groundwater monitoring system in the late 1960s. Analyses of groundwater samples indicated degraded water quality in the water-table aquifer. As a result, DuPont (now Chemours[1]) proposed that groundwater be withdrawn using an interceptor well system (IWS) to prevent off-site migration of groundwater in the B, C, and D aquifers at the Chambers Works Complex. The IWS was installed and placed in operation in 1970 and has been operating continuously since then.

Chemours has established a well designation system to identify wells at the Chambers Works Complex. Each well is identified by a seven-character alpha numeric code (e.g., C11-M02D) and is defined as follows:

- The first three characters denote well location on the alphanumeric grid.
- The fourth through sixth characters identify well type (i.e., M = monitor well, P = piezometer, R = recovery well, and W = water supply well) and well number.
- The seventh character is a letter that identifies the aquifer corresponding to the screened interval of the well (i.e., A, B, C, D, E, and F). Wells screened in more than one aquifer are designated by two letters (e.g., CD). As a result of the Geologic Model Refinement and Well Screen Verification Program [DuPont Environmental Remediation Services (DERS), 1993], several wells were reassigned into other aquifers. When these wells are discussed, the corrected aquifer designation is in parentheses following the well designation [e.g., G04-M01B(C)].

Monitoring Program 1984-1999

In August 1984, the New Jersey Department of Environmental Protection (NJDEP) and DuPont verbally agreed to an Administrative Consent Order (ACO). The modified ACO was signed in 1988 and mandated the continued pumping of the IWS at a minimum rate of 1.5 million gallons per day (mgd) to prevent off-site migration of the contaminated groundwater.

In November 1988, the NJDEP issued a New Jersey Pollutant Discharge Elimination System-Discharge to Groundwater (NJPDES-DGW) permit for the Chambers Works Complex. The permit required the implementation of groundwater quality monitoring and groundwater recovery programs. The groundwater quality monitoring programs included a compliance monitoring program for the Chambers Works Complex and a groundwater monitoring program for the Secure C Landfill for Areas 2 through 4 at the former Carneys Point Works. The groundwater recovery programs required continuation of the IWS and startup of the Delaware River Corrective Action Program (DRCAP) consisting of four recovery wells located along the Delaware River in the southwestern portion of the Chambers Works Complex. This program was designed to contain flow from the B aquifer to the Delaware River south of the basins and was placed online in July 1989.

In 1989, certain waste-specific constituent concentrations increased in two Secure C Landfill point-of-compliance wells located hydraulically downgradient of Areas 1 and 2. DuPont

[1]On February 1, 2015, ownership of the Chambers Works Site was transferred from E.I. du Pont de Nemours and Company (DuPont) to Chemours. On July 1, 2015, the Chemours Company began operating as an independent, publically traded company.

attributed concentration increases to probable releases from Area 1 and believed that the concentrations would attenuate over time as groundwater was recovered from Area 1. The *Chambers Works Remedial Action Plan for the Secure C Landfill-Cell 1* (DERS, 1991) outlined a groundwater recovery system designed to capture the groundwater from Area 1 by pumping wells P21-M01B and Q20-M02B. This system was implemented in 1991.

Waste constituents continued to be detected beyond Area 1 of the Secure C Landfill so DuPont modified the pumping program. Recovery well P21-M01B was replaced by well R20-M02B to facilitate groundwater recovery downgradient of Area 2. The *Secure C Landfill Proposed Corrective Action Program* (DERS, 1994) was approved by the NJDEP and implemented in September 1994. Well R20-M02B continues to operate today. This groundwater recovery system is designed to capture impacted groundwater from Area 1 of the Secure C Landfill.

In 1994, a risk evaluation demonstrated that discontinuing the DRCAP would not adversely affect human health and the environment. Details of this evaluation were submitted in the *Phase I RCRA Facility Investigation Report* (DERS, 1995). The NJDEP and Environmental Protection Agency (EPA) approved termination of the DRCAP system in their July 25, 1995 comments on the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The DRCAP system was shut off on August 25, 1995.

In the second semester of 1995, DuPont conducted a limited aquifer study to determine if the C Basin Well Point System (CBWS), established to alleviate artificially high head in the B aquifer while the C Basin was operating, was still required following backfill and closure of the basin. DuPont submitted the *C Basin Well Point System Hydraulic Groundwater Gradient Evaluation* (DERS, 1995) to the NJDEP in August 1995. The investigation confirmed that the hydraulic gradient of the groundwater within the B aquifer, west of the C Basin, is from the Delaware River into the complex and this same groundwater flow regime exists whether the CBWS is operating. The report recommended that the CBWS no longer be required. The NJDEP approved the proposed termination of the CBWS in a written correspondence, dated August 30, 1995. The system was shut off during September 1995.

In May 1996, DuPont submitted a technical memorandum assessing groundwater containment in the E aquifer along the southern boundary of the Chambers Works Complex (DERS, 1996). Modeling indicated that pumping well J05-W01E at approximately 200 gallons per minute (gpm) is sufficient to contain groundwater along the southern boundary of the Chambers Works Complex. The memorandum proposed continued evaluation of E aquifer containment along the southern plant boundary.

In 1996, DuPont evaluated the Solid Waste Management Unit (SWMU) 5 groundwater control system and concluded that the slurry wall is effective in controlling off-site groundwater migration. However, there is a potential for the A Zone groundwater to flow around the western end of the slurry wall. In order to address this potential, DuPont submitted the technical memorandum dated September 5, 1996, that proposed installing a groundwater collection trench at the western end of the slurry wall to capture groundwater that may be migrating around the slurry wall. In September 1997, DuPont installed a groundwater collection trench at the western end of the SWMU 5 slurry wall to capture A Zone groundwater that could potentially migrate around the slurry wall. The groundwater collection trench was connected to the well-point system and put online in early November 1997. In late 1998, DuPont redesigned the pumping system in order to optimize system performance and reduce pump failures.

On September 23, 1996, DuPont submitted a report on the Chambers Works groundwater optimization model (DERS, 1996). The model indicated that groundwater can be contained on-site in the B, C, and D aquifers at IWS pumping rates much lower than the permit required 1.5 mgd. DuPont proposed a test program to verify the model results and to determine the

optimal IWS pumping rate to more efficiently meet the objectives of protecting human health and the environment. DuPont also requested a minor modification of NJPDES-DGW Permit No. NJ0083429 from an IWS pumping requirement of 1.5 mgd to a monthly average of 1.5 mgd. On November 19, 1996, the NJDEP approved the modification of the IWS pumping requirements from "requiring a pumping rate of 1.5 mgd" to "requiring a monthly average of 1.5 mgd until a different monthly average rate is requested by DuPont and approved by the NJDEP."

In January 1998, DuPont installed six piezometers in the SWMU 5 area to monitor groundwater in the A Zone and to evaluate the performance of the well-point system and groundwater collection trench. DuPont also completed the field work for the Phase II RFI, which included a site-wide groundwater and DNAPL investigation and an investigation of 22 individual SWMUs.

On June 4, 1998, DuPont received agency approval to remove wells P20-M01B and Q23-M03B from the Secure C Landfill Corrective Action Program. The agency also approved the DuPont request to remove 30 wells from the quarterly water-level measurement requirements.

In February 1999, DuPont installed two recovery wells, Q13-R01C and Q13-R01D, as replacements for Q13-R01CD that was abandoned. Improvements to the pipeline were completed at the end of the year 2000. The wells were put online in March 2001.

In July 1999, DuPont added 12 monitoring wells to the Perimeter Monitoring Program (PMP) as requested by NJDEP.

In August 1999, a groundwater discharge assessment by ENVIRON International Corporation shows that concentrations in the B aquifer discharging to the Delaware River are significantly lower than the Ambient Water Quality Criteria (AWQC). DuPont presented this information to the EPA and NJDEP on February 9, 2000.

In September 1999, DuPont Corporate Remediation Group (CRG) began a Non Aqueous Phase Liquid (NAPL) Study in support of the overall RCRA Corrective Action Program at the Chambers Works Plant, as agreed upon with the EPA and NJDEP. The intent of the NAPL Program was to: 1) identify specific well locations where either LNAPL or DNAPL was present, and 2) determine the feasibility of recovering DNAPL from specific wells where the material was present in recoverable quantities. During a September 1999 well survey, NAPL was detected in 14 out of approximately 350 wells on-site. Of these 14 wells, three were found to contain recoverable quantities of DNAPL: two on-site monitoring wells (L13-M01B and I12-M01B) and one interceptor well (H11-R01CD). DNAPL samples were collected from wells L13-M01B and I12-M01B in October 1999 and from well H11-R01CD in December 1999. The samples were analyzed for polychlorinated biphenyl (PCB) Aroclors and PCB congeners using Method 8082, in order to characterize the material for disposal. The accumulated material was managed and disposed as PCB remediated waste per 40 CFR 761 requirements and RCRA hazardous waste regulations.

Monitoring Program 2000-2010

In March 2000, DuPont submitted the Salem Canal Technical Memorandum addressing the potential migration of DNAPL in the B aquifer based on the Phase II RFI Investigation. It was determined that DNAPL migration beneath the canal did not occur, but contamination was detected in the groundwater that would require additional investigation.

In April 2000, two new E aquifer monitoring wells, C11-M01E and G04-M01E, were installed. The new geologic information verifies the hydrogeologic model reported in the *Geologic Model Refinement and Well Screen Verification Program* (DERS, 1993). The updated cross sections

are included in Figures 28, 29, and 30 of the *Second Semester 2000 Semi-Annual Report* (DuPont CRG, 2001).

On April 28, 2000, DuPont received agency approval to abandon 66 monitoring wells that are no longer used for quarterly groundwater elevation mapping and the ten well points that are no longer being used as part of the SWMU 5 groundwater water collection system.

In August 2000, DuPont submitted the quality assurance/quality control program; *Environmental Data Quality Assurance and Quality Control Program*, (DuPont CRG, 2000).

In October 2000, DuPont installed wells J12-M01B and J12-M02B in the vicinity of the remediated SMWU 56 ODCB Area. The wells were installed to monitor for DNAPL at the base of the B aquifer.

In 2001, DuPont instituted a monthly NAPL survey to monitor the 14 original wells, plus the two J12 wells, for the presence of NAPL. The current (2014) list of wells in the Monthly NAPL Survey includes the following wells:

- G05-M03B
- G05-M02B
- G06-M03B
- I12-M02B
- J10-M02B
- J12-M01B
- J12-M02B
- K11-M01B
- L12-M03B
- L13-M01B
- M12-M02B
- G06-M04B
- D15-M01C
- H11-R01CD
- L13-M02B
- M12-M04B
- G06-M02B

In April 2001, DuPont submitted the Salem Canal Supplemental Investigation Technical Memorandum. The memorandum concluded that groundwater flow is northwesterly towards the Salem Canal with a groundwater gradient of less than one percent. The extent of groundwater contamination is limited to a small area in the parking lot where engineering and administrative controls exist. DuPont received agency approval on August 27, 2001, for no additional work in the area and to abandon the ten temporary piezometers.

On April 16, 2001, DuPont received agency approval for the lateral expansion at the C Landfill. This includes construction of Area 5A, which provides an additional 217,000 cubic yards of waste capacity, as well as vertical expansion providing an additional 24,000 cubic yards of capacity to the existing landfill. Construction of Area 5A was completed and began accepting material in July 2001.

In May and June of 2001, DuPont abandoned 67 monitoring wells that were no longer used for quarterly groundwater elevation mapping and ten well points that were no longer being used as part of the SWMU 5 groundwater water collection system.

In July 2001, DuPont added 1,2-dichloropropane, ethylbenzene, and xylenes (total) to the Secure C Landfill Detection Monitoring Program (CLF-DM) target analyte list.

On May 21, 2002, DuPont received agency approval to reduce the frequency of groundwater elevation maps from quarterly to semi-annually.

In a department letter dated January 7, 2003, it was stated that further radioactive isotope groundwater sampling on the A and B Sanitary Landfill was not required. According to the Solid Waste Facility Permit #1713B, issued on June 7, 2001, two upgradient wells (R09-M01B and U12-M01A), one downgradient well (O12-M01B), and one interceptor well (Q13-R01C) were sampled for four quarters and screened for the presence of radioactive isotopes. The first

sampling event occurred in October 2001, and the final sampling event was completed in July 2002.

In April 2002, DuPont completed work on SWMUs 5 and 43. Completed activities included the following:

- Installed a 1,400-foot long sheet-pile retaining wall to stabilize the shoreline and enhance groundwater containment in both the A Zone and B aquifer.
- Removed 11,400 cubic yards of contaminated sediment in the intertidal and subtidal zones.
- Drained the SWMU 43 pond and subsequently filled it with approximately 21,000 cubic yards of clean fill.

On February 3, 2003, DuPont received agency approval of the RFI Phase III RCRA Facility Investigation Report contingent upon a response to comments. In a DuPont email to the EPA and NJDEP, dated February 19, 2003, DuPont agreed to sample four B aquifer wells as part of the RCRA SWMU post-closure plan. The four wells added to the RCRA Units Post Closure Monitoring Program are downgradient of their respective SWMUs and will be sampled annually beginning in July 2003. Well L12-M01B will monitor SWMU 21, well C09-M01B will monitor SWMU 25, well G14-M01B will monitor SWMU 26, and well C08-M01B will monitor SWMU 28.

On December 20, 2002, the RFI Phase III tidal study was conducted after the completion of the SMWUs 5 and 43 remediation activities and submitted under separated cover to the agencies. DuPont received agency approval of the report on March 18, 2003. The semi-annual water-level sampling schedule was revised based on the results of the tidal study. Also, as agreed to with the EPA and NJDEP, DuPont added well F16-M10B to the PMP to monitor groundwater quality in the areas behind the slurry and sheet-pile walls.

In April 2005, Area 5B of the Secure C Landfill began receiving waste and was added to the Leachate Collection System Monitoring Program.

As agreed by NJDEP in a letter dated May 27, 2005, monitoring well C11-M01B was removed from the perimeter monitoring program since it has shown low piezometric head values and long lag times. A replacement well, C11-M03B was installed in the immediate vicinity in December 2005. C11-M03B was sampled as part of the PMP during the July 2006 sampling event.

On July 1, 2005 DuPont presented a long-term remedial strategy in a letter to the NJDEP in response to the April 5, 2005 Delaware River Initiative letter. In the letter it was recommended to complete an optimization study of the IWS to reduce the amount of groundwater recovered while still maintaining hydraulic containment at the site perimeter in accordance with the long-term strategy. Results of the study indicated that the optimum pumping scenario identified for the site includes five pumping wells recovering approximately 1 mgd or 700 gpm. The optimized scenario was based on the groundwater modeling reported in the October 2007 *Groundwater Flow and Optimization Models Report* (submitted as Appendix H in the October 2007 *First Semester 2007 Semi-Annual NJDEP-DGW Report*)

On December 21, 2005 The *Phase IV Supplemental RFI Work Plan* was submitted to the EPA and NJDEP. DuPont received agency approval and field activities began in August 2006.

In April 2006, monitoring wells Z20-M01B and Z20-M01C were reassigned to the B and C aquifers, respectively in April 2006. Previously, they were assigned to the C and D aquifers. A review of the local geology and hydrogeology showed that the wells were more representative as B and C aquifers wells, respectively.

Sodium was added to the Leachate Collection Detection System Analyte List as recommended in the Second Semester 2005 Semi-Annual NJPDES-DGW Report (April 2006).

NJPDES-DGW Permit No. NJ0083429, modified May 1, 2006, requires the monitoring of 33 wells for PFOA. Results will be submitted to NJDEP within 90 days of sampling. The PFOA Monitoring Program monitors 36 wells for 13 perfluorinated compounds (PFCs) semi-annually in compliance with NJPDES-DGW Permit No. NJ0083429. Results of the sampling events are submitted to NJDEP within 90 days of sampling and are also presented in the corresponding semi-annual NJPDES-DGW reports. The first sampling event occurred in July 2006.

In July 2006, corrective action well R20-M02B at the Secure C Landfill stopped pumping due, in part, to a clogged pipeline. It was also later discovered that the screen was severely damaged. The well was abandoned in November 2006. Replacement well, P21-R01B, was installed in December 2006 for the abandoned well R20-M02B. DuPont received NJDEP approval to the minor modification to its Water Allocation Permit in April 2007. New pumping well P21-R01B became operational in October 2007.

In July 2006 remediation activities began at SWMU 52 following *SWMU 52 Interim Stabilization Measure Work Plan* (January 2006) as approved by the NJDEP. NJDEP also approved the DuPont request to put the non-hazardous soils from SWMU 52 into the vault. The SWMU 52 ISM remedial activities were completed in January 2007. Upon completion of the SWMU 52 ISM, the A Basin Soil Vault was capped and closed. A Remedial Action Report for the SWMU 52 ISM was submitted in March 2007

On December 26, 2006 DuPont submitted a *Preliminary Assessment Report (PAR)*, which outlined the history of the site to the EPA and NJDEP. The PAR identified potential sources within the active Chambers Works manufacturing area where particular types of production processes were located. Eleven areas of concern (AOCs) were recommended for further investigation. The AOCs are large, cover previously investigated SWMUs. The PAR was approved by EPA (EPA, 2008) and the 11 AOCs were added to the HSWA permit, therefore becoming part of the RCRA Corrective Action Program.

In late 2006 to early 2007, the *Delaware River Groundwater to Surface-Water Investigation* was performed in accordance with the NJDEP approved work plan (DuPont, 2005). The investigation was completed in multiple phases. Phase I consisted of a bathymetric survey, geophysical investigations and intrusive sediment characterization to determine sediment thickness, underlying B aquifer thickness and the B/C clay elevation. Phase I also included a visual inspection of the sea wall during low tide to look for compromised structural integrity or groundwater seeps from the A zone.

In January 2007 twelve perfluorinated compounds were added and sampled as part of the PFOA Monitoring Program.

On February 13, 2007 the report *DuPont Chambers Works Ecological Investigation Work Plan* was submitted to NJDEP to address recommendations made in the September 18, 2006 *Baseline Ecological Investigation*. Field activities began in March 2007 and were completed in March 2008. DuPont submitted the findings of the investigation in the *Ecological Investigation Report* in March 2009. Additional sampling was completed in Bouttown Creek's ditch system in October 2009 and was documented in the Summary of Ecological Investigations in Carneys Point (URS, 2010b). A weight of evidence evaluation of ecological risks based on the findings recommended no additional investigations were necessary. In a letter dated December 6, 2010 NJDEP Bureau of Environmental Evaluation and Risk Assessment, Environmental Toxicology and Risk Assessment (BEERA/ETRA) supported the recommendation for no further investigation, provided environmental conditions in Bouttown Creek do not change dramatically.

In April 2007, three additional monitoring wells were installed and added to the PFOA Monitoring Program as requested by NJDEP after reviewing the *Site Investigation Report for PFOA* (DuPont CRG, 2006). These wells were first sampled as part of the second semester 2007 PFOA Monitoring Program.

In August 2007, Area 7 of the Secure C Landfill began receiving waste and was added to the Leachate Collection System Monitoring Program.

In August 2007 a report titled *Phase IV Supplemental Report* was submitted to the NJDEP with updated fact sheets for each SWMU.

In December 2007, as a result of the discovery of PCB-containing NAPL during the installation of well T29-P01A, follow-up investigations was conducted in December 2007, February/March 2008 and June 2008 to delineate the source area and determine the extent of the NAPL. DuPont submitted the T29 Area Polychlorinated Biphenyls (PCB) Removal Work Plan in August 2009 to EPA's Toxic Substances Act (TSCA) task force. EPA approved the work plan on October 16, 2009. Permits were obtained and remediation of the area began on July 2011 and was completed by August 2011.

In March 2008, Phase 2 of the Delaware River Groundwater to Surface-Water investigation which consisted of installation of temporary wells and groundwater sampling was completed. Phase 3, was also completed in March 2008. Phase 3 consisted of collecting sediment samples and conducting biodegradation study to evaluate the ability of indigenous microbes to degrade site-related constituents. The results of these investigations were submitted to the NJDEP in the *Delaware River Site Investigation Report* in December 2008.

On September 17, 2008, DuPont obtained NJDEP approval to allow a 90-day testing period of the optimized IWS (email) and began the testing period on June 26, 2009. The field test purpose was to demonstrate that the groundwater capture could be achieved at an optimized flow rate of 1.0 mgd as predicted by the model. The new IWS pumping rate of 1.0 mgd became effective with the new NJPDES-DGW Permit Number NJ0083429 on May 1, 2010.

Corrective action well P21-M03B collapsed and was abandoned on September 17, 2008. The replacement well P21-M04B was installed in January 2009. The new well was first sampled in February 2009.

In August 2008, it was determined that the J05-W01E pumping well system required pipeline replacement in order to continue the E aquifer groundwater recovery program. From August 2008 until January 2010 the J05-W01E pumping system was off-line from while the area was being evaluated as part of the IWS optimization. NJDEP agreed upon temporary pump shutdown as part of the associated IWS optimization plan in an email dated September 17, 2008. Quarterly monitoring of downgradient E aquifer wells, J04-M01E and G04-M01E, located to the south of the Salem Canal for the detection of site constituents began in July 2009. The pump and pipeline was replaced and pumping resumed in February 2010, the analytical data showed no increase in the two downgradient well; therefore, it was recommended that quarterly monitoring end, and sampling frequency at G04-M01E and J04-M01E be reduced to annual.

In 2009, a follow up ecological investigation recommendations were outline in the Delaware River Remedial Investigation Work Plan (URS, 2009). DuPont collected additional surface-water and sediment samples as outlined in the work plan in September 2009.

On February 6 2009, a work plan titled *Delaware River NAPL Delineation Work Plan* was submitted to the NJDEP. The purpose of the investigation was to address NAPL that was discovered in the B aquifer at one sample location off-shore from the Fluoroproducts area during the Phase 2 Delaware River Groundwater to Surface-Water Investigation. Off-shore

delineation was completed in March 2009 and the results were reported in the August 2010 *Perimeter Investigation Report* as Appendix L.

In October 2009 a Perimeter Investigation Sampling Plan was submitted to the NJDEP and EPA. Field work was completed in late December 2009.

Monitoring Program 2010- Present

Upon completion of the SWMU 52 ISM, the A Basin Soil Vault was capped and closed. The NJDEP has approved the A and B Basin closure conditioned on a fully executed Declaration of Environmental Restriction (DER), with the exception of the A Basin vault. A deed notice for the A and B Basins (along with 15 other SWMUs) has been approved by the NJDEP and recorded in Salem County. A copy of the recorded deed notice has been submitted to the NJDEP. The A Basin Vault leachate system became operational in March 2010, and a Remedial Action Report for the A Basin Vault was submitted in mid-2010.

On May 1, 2010 the new IWS pumping rate of 1.0 mgd became effective with the new NJPDES-DGW Permit Number NJ0083429.

In August 2010 The Perimeter Investigation Report (URS, 2010), was submitted to the NJDEP and EPA. The investigation identified three shallow groundwater plumes in the manufacturing area that may migrate to the Delaware River as a result of incomplete capture of the B aquifer by the IWS. The plumes were noted to be located in the Fluoroproducts Area (AOC 1), former Tetraethyl Lead (TEL) Area (AOC 2) and the in the western portion of the Jackson Lab area (AOC 3).

In October 2010 The Delaware River Ecological Investigation completed its third and final phase of sampling. A report was submitted with finds from the investigation and recommendations to the NJDEP (URS, 2011). DuPont received a comment letter from the NJDEP in September 2012.

In November, 2010 the DuPont Chambers Works Classification Exception Area (CEA) Biennial Certification Report was submitted to the NJDEP. A NJDEP CEA was established to provide public notice that the constituent standards for a given aquifer classification (Class II A drinking water) are not being met due to anthropogenic influences. Chambers Works CEA 1 encompasses the entire complex.

In July 2011, a shallow B aquifer pumping well D15-R01B was installed to obtain capture from the plume. Pump Test were completed from April 2012 through May 2012. An initial pre-design investigation was developed which included the installation of piezometers for pump test measurements. NAPL was observed in one piezometer, D15-P08B. D15-P08B was added to the NAPL survey and recovery list in 2014.

In 2011, it was determined that the pump associated with recovery well J05-W01E was failing and would need to be replaced. Pump replacement and well assessment activities occurred from January 30 thru the week of February 6, 2012.

On November 28, 2012, a CEA/Well Restriction Area (WRA) Permit Fact Sheet was submitted along with the *DuPont Chambers Works Classification Exception Area (CEA) Biennial Certification Report* (submitted electronically November 2, 2012).

In December 2012, the *Perimeter Area (AOCs 1, 2, & 3) Remedial Action Selection Report (RASR)* was prepared by Geosyntec Consultants and submitted to NJDEP and EPA.

In December 2012, six additional E aquifer monitoring wells were installed so as to refine the understanding of the groundwater quality in the E aquifer at the southern end of the site.

In 2013, a data gap analysis was performed for site solid waste management units (SWMUs) and areas of concern (AOCs). Data gaps identified were included in the *RFI Data Gap Sampling Plan* (URS, 2013a). The plan was approved by NJDEP in December 2013. The data gap field investigation was completed in February 2014. The 2014 RFI report presents a comprehensive summary of data collected from prior RFI phases and associated investigations, and integrates the data and information collected during the most recent 2013-14 RFI data gap investigation.

In early 2013 the Salem Canal steel sheet-pile barrier (SPB) that was installed in 2008 was extended to the Munson Dam area. Based on March 11, 2013 water level data, groundwater elevations have risen behind the SPB, indicating the SPB is effectively inhibiting flow from the B aquifer to the Salem Canal. Additional studies to monitor the effect of the SPB on groundwater flow and quality and the condition of the sediments within the Salem Canal area were documented with detail analysis and conclusions are summarized in the *Salem Canal Groundwater Remedial Action Progress and Sediment Investigation Status Report* (URS, 2013).

In an email dated April 29, 2013, the NJDEP approved the recommendation to resume annual sampling of J04-M02E and G04-M01E.

In June 2013, DuPont installed one injection well with a cluster of 12 monitoring points within a 30-foot by 30-foot square area to support hydraulic characterization of passive aerobic biostimulation activities. As part of the hydrogeology assessment activities, in August 2013, DuPont request a 180-calendar day Permit-By-Rule (PBR) so as to discharge potassium bromide (KBr) (as a tracer for hydraulic testing), oxygen, monopotassium phosphate, and ammonium chloride as nutrients for enhancing aerobic degradation. On October 16, 2013, DuPont received the PBR approval with L07-M01B to be added to the sampling program as an upgradient well. On November 12, 2013 injection of the KBr test started. During an attempt to install the Waterloo Emitter™ into L07-M02B, the emitter failed to reach the bottom of the well and it was determined that the well collapsed. The well was replaced and the oxygen diffusion testing was started.

In a letter dated December 2, 2013, the NJDEP commented on the *2013 RFI Data Gap Sampling Plan.* NJDEP requested a review historical PFOA/PFC soil and groundwater investigations and DGW program for data gaps. Based on the site wide evaluation it was determined that potential data gaps existed in the manufacturing area that could be filled by additional sampling of 15 monitoring wells for PFOA/PFCs analytes. Samples were collected in January 2014.

In letters dated March 13 and April 25, 2017, NJDEP provided comments on the Second Semester 2016 NJPDES-DGW Report. In response to those comments, the following updates will be included to the NJPDES-DGW program going forward:

- Starting in the second semester of 2017, EPA method 537 Modified was used for the PFOA Monitoring Program. Method 537 Modified is also currently used for other monitoring programs at Chambers Works and includes perfluorotridecanoic acid (PFTrA) and perfluorotetradecanoic acid (PFTeDA), as requested by the agencies.
- Also starting in the second semester of 2017, 1,4-dioxane and Freon® 113 were added to the volatile organic compound (VOC) analyte list for all areas where VOC sampling is required.

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Appendix B

Water-Level Measurements with Well Assignments by Aquifer

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
F16-P01A	8.98	10/23/2018	316513.23	209625.94	10.17	A	1.19	Yes	
G16-M01A	4.04	10/23/2018	316505.90	209825.14	7.83	A	3.79	Yes	
G16-M02A	4.59	10/23/2018	316519.60	209854.61	8.41	A	3.82	Yes	
G16-P01A	5.03	10/23/2018	316243.96	210071.58	6.60	A	1.57	Yes	
G16-P02A	4.85	10/23/2018	316331.88	209705.45	8.39	A	3.54	Yes	
G16-P03A	3.11	10/23/2018	316454.66	209923.41	6.87	A	3.76	Yes	
G16-P04A	3.41	10/23/2018	316469.05	209927.42	7.09	A	3.68	Yes	
H16-P01A	3.98	10/23/2018	316521.90	210086.14	7.83	A	3.85	Yes	
H16-P02A	3.94	10/23/2018	316396.78	210122.53	4.06	A	0.12	Yes	
H17-M01A	4.82	10/23/2018	316664.54	210155.33	8.57	A	3.75	Yes	
H17-P01A	3.98	10/23/2018	316605.34	210414.25	7.10	A	3.12	Yes	
I17-M01A	4.99	10/23/2018	316730.62	210492.85	8.35	A	4.02	Yes	
I17-M02A	4.50	10/23/2018	316758.48	210532.19	8.41	A	3.91	Yes	
I17-P01A	3.11	10/23/2018	316680.16	210514.48	3.90	A	0.79	Yes	
I17-P02A	3.21	10/23/2018	316667.50	210583.17	3.76	A	0.55	Yes	
AA25-M02B	4.60	10/23/2018	319845.21	217831.02	4.59	B	-0.01	Yes	
C06-P01B	6.2	10/23/2018	312548.33	208106.50	6.65	B	0.45	Yes	
C08-M01B	8.73	10/23/2018	313232.71	208093.52	10.16	B	1.43	Yes	
C10-M02B	7.78	10/23/2018	313823.84	208140.89	8.88	B	1.10	Yes	
C11-M03B	5.13	10/23/2018	314425.98	208214.74	7.52	B	2.68	Yes	
C14-P01A	7.88	10/23/2018	315554.75	208426.07	8.50	B	0.62	Yes	
D06-M01B	7.93	10/23/2018	312300.27	208513.18	8.89	B	0.96	Yes	
D06-P01B	3.82	10/23/2018	312544.77	208833.31	6.27	B	2.45	Yes	
D07-M01B	8.10	10/23/2018	312829.78	208685.02	10.96	B	2.86	Yes	
D08-P03B	9.87	10/23/2018	313369.29	208856.72	12.20	B	2.33	Yes	
D09-P01B	8.07	10/23/2018	313597.21	208538.58	10.73	B	2.66	Yes	
D11-M01B	5.22	10/23/2018	314422.16	208672.86	6.14	B	0.92	No	
D11-P01B	0.85	10/23/2018	314038.59	208651.48	3.30	B	2.45	Yes	
D13-M01B	3.88	10/23/2018	315192.66	208815.88	5.27	B	1.39	Yes	
D14-M01B	3.26	10/23/2018	315566.94	208594.23	5.26	B	2.00	Yes	
D14-P01B	5.81	10/23/2018	315394.71	208689.16	7.67	B	1.86	Yes	
D15-M01B	4.03	10/23/2018	315926.26	208756.30	6.06	B	2.03	Yes	
E07-P01B	3.69	10/23/2018	312926.08	209190.93	5.86	B	2.17	Yes	
E11-P01B	5.25	10/23/2018	314247.03	208943.41	6.69	B	1.44	Yes	
E15-M01B	4.42	10/23/2018	316163.69	209158.77	6.35	B	1.93	Yes	
E15-P03B	2.06	10/23/2018	315890.52	209396.23	3.92	B	1.86	Yes	
F05-M02B	6.23	10/23/2018	312090.01	209522.65	8.03	B	1.80	Yes	
F06-M02B	6.05	10/23/2018	312194.06	209284.33	7.94	B	1.89	Yes	
F06-P01B	4.33	10/23/2018	312460.86	209639.86	6.34	B	2.01	Yes	
F08-M01B	6.92	10/23/2018	313304.79	209572.16	8.98	B	2.06	Yes	
F11-M01B	6.58	10/23/2018	314404.19	209638.15	8.05	B	1.47	Yes	
F16-M01B	8.33	10/23/2018	316502.90	209622.81	9.85	B	1.52	Yes	
G04-M02B	7.49	10/23/2018	311699.06	209768.91	8.14	B	0.65	Yes	
G04-M03B	9.66	10/23/2018	311474.01	209811.25	10.70	B	1.04	Yes	
G05-M02B	5.60	10/23/2018	312128.77	209816.33	7.57	B	1.97	Yes	
G05-M03B	5.24	10/23/2018	312105.60	209877.25	7.46	B	2.22	Yes	
G05-P03B	5.41	10/23/2018	312007.97	209981.70	7.36	B	1.95	Yes	

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Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
G06-M03B	6.91	10/23/2018	312267.85	209908.77	10.04	B	3.13	No	
G06-M04B	8.1	10/23/2018	312248.51	209908.22	11.12	B	2.22	Yes	
G09-M01B	6.27	10/23/2018	313650.93	209751.79	7.80	B	1.53	Yes	
G10-M03B	8.08	10/23/2018	313847.51	209994.35	9.41	B	1.33	Yes	
G14-M01B	5.64	10/23/2018	315431.36	209820.25	6.56	B	0.92	Yes	
G16-M03B	5.50	10/23/2018	316512.78	209824.01	7.55	B	2.05	Yes	
G16-M04B	5.67	10/23/2018	316520.94	209862.70	7.48	B	1.98	Yes	
H04-M02B	9.30	10/23/2018	311616.97	210149.28	7.73	B	2.06	Yes	
H05-M01B	5.70	10/23/2018	311975.53	210083.38	6.12	B	-3.18	Yes	
H05-M02B	4.58	10/23/2018	311945.06	210259.40	7.19	B	1.49	Yes	
H06-M02B	7.28	10/23/2018	312446.99	210316.11	9.11	B	4.53	Yes	
H10-M01B	5.38	10/23/2018	313902.56	210342.77	6.62	B	1.24	Yes	
H13-M01A	7.78	10/23/2018	315327.16	210376.64	9.35	B	1.57	Yes	
H13-M02B	12.80	10/23/2018	315159.91	210353.41	11.22	B	-1.58	Yes	
H13-P01B	4.64	10/23/2018	315142.36	210194.10	5.08	B	0.44	Yes	
H14-M01B	9.89	10/23/2018	315650.28	210110.67	11.23	B	1.34	Yes	
H15-M01B	9.58	10/23/2018	315960.96	210368.31	7.62	B	-1.96	Yes	
H15-P02B	7.78	10/23/2018	315985.72	210125.10	8.92	B	1.14	Yes	
H16-M02B	7.94	10/23/2018	316513.39	210089.12	9.69	B	1.75	Yes	
H17-M02B	6.79	10/23/2018	316788.01	210444.12	8.23	B	1.44	Yes	
H17-M03B	4.70	10/23/2018	316668.87	210165.83	8.38	B	3.68	Yes	
I05-M01B	7.36	10/23/2018	311886.54	210573.08	8.17	B	0.81	Yes	
I05-M02B	9.14	10/23/2018	312030.17	210568.25	10.10	B	0.96	Yes	
I12-M02B	9.58	10/23/2018	314790.06	210547.29	6.41	B	-3.17	No	
J04-M01B	7.35	10/23/2018	311573.40	210814.59	8.04	B	0.69	Yes	
J05-M02B	12.51	10/23/2018	311817.45	211053.52	10.46	B	-2.05	No	
J07-M01B	10.48	10/23/2018	312644.57	211185.04	11.19	B	0.71	Yes	
J10-M02B	7.83	10/23/2018	313905.74	211138.36	8.19	B	0.36	Yes	
J12-M02B	6.64	10/23/2018	314921.66	211114.07	5.44	B	-1.20	Yes	
J16-M01B	7.50	10/23/2018	316510.66	211153.16	5.38	B	-2.12	Yes	
J17-M01B	10.60	10/23/2018	316739.28	210934.01	9.18	B	-1.42	Yes	
K08-M01B	11.42	10/23/2018	313316.04	211342.56	12.56	B	1.14	Yes	
K10-M01B	7.72	10/23/2018	314077.61	211642.28	6.87	B	-0.85	Yes	
K11-M01B	8.21	10/23/2018	314562.30	211414.30	6.77	B	-1.44	Yes	
K12-M01B	6.55	10/23/2018	314869.31	211359.06	6.51	B	-0.04	Yes	
K13-M02B	7.51	10/23/2018	315289.17	211433.46	5.50	B	-2.01	Yes	
K16-M01B	9.30	10/23/2018	316179.03	211489.57	5.82	B	-3.48	Yes	
K17-M01B	6.34	10/23/2018	316646.71	211553.91	2.48	B	-3.86	Yes	
K18-P01B	11.36	10/23/2018	317113.10	211403.12	8.80	B	-2.56	Yes	
L04-M01B	12.83	10/23/2018	311538.24	211690.83	13.45	B	0.62	Yes	
L05-M01B	11.87	10/23/2018	312034.84	211958.07	12.60	B	0.73	Yes	
L07-M01B	12.11	10/23/2018	312627.81	211771.34	11.98	B	-0.13	Yes	
L08-M01B	12.83	10/23/2018	313082.82	212008.57	11.85	B	-0.98	Yes	
L12-M01B	9.80	10/23/2018	314884.93	211755.90	8.19	B	-1.61	Yes	
L12-M02B	12.96	10/23/2018	314709.36	212022.91	11.41	B	-1.55	Yes	
L13-M02B	7.65	10/23/2018	315030.25	211850.28	5.70	B	-1.95	Yes	
L14-M01B	11.81	10/23/2018	315587.42	211984.59	8.65	B	-3.16	Yes	

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
L15-M01B	9.95	10/23/2018	315886.06	211972.93	4.71	B	-5.24	Yes	
L16-M01B	5.70	10/23/2018	316513.09	212028.31	1.33	B	-4.37	Yes	
L19-M01B	12.90	10/23/2018	317379.16	211742.32	9.87	B	-3.03	Yes	
M03-M01B	9.80	10/23/2018	311169.72	212334.59	9.90	B	0.10	Yes	
M10-M01B	16.14	10/23/2018	314071.44	212113.35	14.90	B	-1.24	Yes	
M10-M02B	14.45	10/23/2018	314059.40	212114.24	14.36	B	-0.09	Yes	
M10-M03B	17.22	10/23/2018	314147.11	212428.32	15.84	B	-1.38	Yes	
M10-M04B	20.44	10/23/2018	313757.94	212205.27	19.21	B	-1.23	Yes	
M15-M01B	6.84	10/23/2018	315986.48	212376.05	2.65	B	-4.19	Yes	
M15-M02B	10.66	10/23/2018	315871.59	212240.19	5.23	B	-5.43	Yes	
N04-M01B	7.40	10/23/2018	311550.88	212525.68	7.42	B	0.02	Yes	
N08-M01B	6.51	10/23/2018	313109.14	212761.83	5.51	B	-1.00	Yes	
O05-M01B	8.35	10/23/2018	312014.88	212924.77	8.10	B	-0.25	Yes	
O10-M01B	15.76	10/23/2018	314156.65	212703.59	14.68	B	-1.08	Yes	
O11-M01B	16.16	10/23/2018	314299.05	212887.70	14.64	B	-1.52	Yes	
O12-M01B	10.87	10/23/2018	314821.32	213039.13	9.57	B	-1.30	Yes	
O12-M03B	22.35	10/23/2018	314651.47	213290.28	21.29	B	-1.06	Yes	
O12-M04B	13.48	10/23/2018	314837.45	213039.86	12.18	B	-1.30	Yes	
O16-P01B	5.29	10/23/2018	316247.17	213224.72	3.19	B	-2.10	Yes	
O26-M01B	6.61	10/23/2018	320162.40	213024.90	6.24	B	-0.37	Yes	
P06-M01B	5.11	10/23/2018	312331.23	213392.26	4.54	B	-0.57	Yes	
P07-M01B	7.91	10/23/2018	312637.48	213430.39	7.18	B	-0.73	Yes	
P11-M01B	13.49	10/23/2018	314227.93	213507.67	12.65	B	-0.84	Yes	
P20-M01B	5.13	10/23/2018	317972.50	213507.60	4.26	B	-0.87	Yes	
P21-M01B	6.77	10/23/2018	318309.77	213664.47	5.83	B	-0.94	Yes	
P21-M04B	5.83	10/23/2018	318180.43	213677.23	4.90	B	-0.93	Yes	
P21-R01B	12.34	10/23/2018	318320.01	213590.56	5.20	B	-7.14	Yes	10 GPM
Q12-M01B	14.45	10/23/2018	314718.45	213789.62	13.67	B	-0.78	Yes	
Q13-M02B	8.03	10/23/2018	315149.13	213834.25	7.06	B	-7.39	Yes	
Q20-M03B	2.55	10/23/2018	317781.97	213710.85	1.56	B	-6.47	Yes	
Q20-R01B	3.69	10/23/2018	318025.69	213843.98	2.82	B	-19.36	Yes	Pumping well offline
Q21-M01B	6.40	10/23/2018	318166.24	213804.58	5.60	B	1.91	Yes	
Q22-M01B	5.46	10/23/2018	318890.12	213754.38	4.65	B	-1.75	Yes	
Q23-M01B	5.08	10/23/2018	319188.29	213927.76	4.06	B	-1.40	Yes	
Q25-P01B	3.82	10/23/2018	320011.53	214019.53	3.41	B	-1.67	Yes	
Q27-M01B	11.85	10/23/2018	320769.43	213810.53	12.17	B	8.35	Yes	
R08-M01B	7.9	10/23/2018	313001.23	214115.09	7.13	B	-4.72	Yes	
R09-M01B	6.03	10/23/2018	313359.28	214328.09	5.22	B	-0.81	Yes	
R09-M02B	10.52	10/23/2018	313702.67	214173.29	9.89	B	-0.63	Yes	
R09-M03B	9.39	10/23/2018	313400.72	214054.62	8.55	B	-0.84	Yes	
R12-M01A	7.42	10/23/2018	314644.71	214455.94	7.40	B	-0.02	Yes	
R13-M01A	7.04	10/23/2018	315083.34	214333.75	6.76	B	-0.28	Yes	
R15-M01A	9.41	10/23/2018	315982.12	214379.38	8.21	B	-1.20	Yes	
R19-M01B	8.80	10/23/2018	317738.22	214306.55	7.98	B	-0.82	Yes	
R31-M01B	6.50	10/23/2018	322322.80	214179.93	7.24	B	0.74	Yes	
S11-M01B	9.82	10/23/2018	314219.32	214634.42	8.32	B	-1.50	Yes	
S19-M01B	4.75	10/23/2018	317513.31	214578.90	3.83	B	-0.92	Yes	

AECOM

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
S23-P02B	10.19	10/23/2018	319165.31	214592.77	8.34	B	-1.85	Yes	
S24-M01B	4.49	10/23/2018	319439.44	214904.89	3.99	B	-0.50	Yes	
S32-M03B	6.72	10/23/2018	322570.00	214865.00	7.13	B	0.41	Yes	
T14-M01A	5.37	10/23/2018	315708.28	215166.28	4.57	B	-0.80	Yes	
T20-M02B	9.28	10/23/2018	317764.32	214962.08	8.57	B	-0.71	Yes	
T21-M01A	10.28	10/23/2018	318209.75	214964.87	9.91	B	-0.37	Yes	
T22-M01B	7.20	10/23/2018	318684.74	214928.99	6.70	B	-0.50	Yes	
U08-M01B	4.86	10/23/2018	313306.15	215322.07	4.77	B	-0.09	Yes	
U12-M01A	1.60	10/23/2018	314807.58	215314.35	1.56	B	-3.30	Yes	
U14-M01A	7.11	10/23/2018	315405.88	215412.45	6.47	B	4.87	Yes	
W19-M01B	9.09	10/23/2018	317511.94	216327.52	9.05	B	1.94	Yes	
X17-M01B	4.85	10/23/2018	316649.76	216691.37	4.93	B	-4.16	Yes	
X18-M01B	9.88	10/23/2018	317063.21	216768.31	10.51	B	5.66	Yes	
X26-M01A	2.73	10/23/2018	320182.55	216788.05	2.69	B	-7.19	Yes	
X27-M01B	2.65	10/23/2018	320686.55	216547.31	2.53	B	-0.20	Yes	
Y21-M01B	7.67	10/23/2018	318180.39	217017.01	8.65	B	6.00	Yes	
Z20-M01B	8.75	10/23/2018	317921.64	217663.87	10.89	B	3.22	Yes	
Z28-M02B	5.57	10/23/2018	321133.91	217580.10	5.83	B	-2.92	Yes	
C13-BM01	14.04	10/23/2018	315365.09	208022.32	15.65	BM	1.94	Yes	
E05-BM01	9.80	10/23/2018	311999.68	209210.29	8.39	BM	2.82	Yes	Munson Dam Canal - SE side of dam (mid rail), mid-rail black electrical tape
E05-BM02	8.83	10/23/2018	312101.31	209190.35	8.29	BM	-5.75	Yes	Munson Dam River - Gate 11B (mid rail), Top rail about vertical support, above yellow ladder hanger
H16-BM02	10.36	10/23/2018	316356.19	210236.07	7.57	BM	-2.23	Yes	B-Basin - posted for reference
L19-BM02	2.04	10/23/2018	317542.71	211919.79	1.42	BM	-0.62	Yes	Henby #1 - posted for reference
T16-BM01	1.35	10/23/2018	316277.89	214924.33	-0.12	BM	-1.47	Yes	From water ***Henby #2 - posted for reference. Needs washer
U30-BM01	3.90	10/23/2018	322092.02	215333.80	3.39	BM	-0.51	Yes	Top of wall
X24-BM01	0.95	10/23/2018	319567.34	216799.96	0.59	BM	-0.36	Yes	Off head wall ***Bouttown #2 - posted for reference. Top of PVC.
AA25-M01B	3.79	10/23/2018	319844.72	217815.66	3.82	C	0.03	Yes	
C06-M01C	14.04	10/23/2018	312519.67	208072.12	9.81	C	-4.23	Yes	
C10-M01C	11.34	10/23/2018	314099.44	208187.62	8.68	C	-2.66	Yes	
C11-M01C	8.21	10/23/2018	314509.50	208215.22	5.79	C	-2.42	Yes	
C14-M01C	7.99	10/23/2018	315469.72	208446.91	7.66	C	-0.33	Yes	
D15-M01C	6.05	10/23/2018	315935.38	208756.55	5.83	C	-0.22	Yes	
E14-M01C	8.33	10/23/2018	315630.10	209040.08	7.19	C	-1.14	Yes	
F09-M01C	13.65	10/23/2018	313405.25	209259.18	8.91	C	-4.74	Yes	
G04-M01C	14.49	10/23/2018	311477.98	209799.57	10.61	C	-3.88	Yes	
G08-M01C	15.47	10/23/2018	313213.48	209924.63	8.73	C	-6.74	Yes	
G08-R01C	44.48	10/23/2018	313252.91	209941.61	8.26	C	-36.22	Yes	80 GPM
G12-M01C	NM	10/23/2018	314611.65	209810.52	4.95	C	NM	Yes	
H04-M01B	6.80	10/23/2018	311618.74	210144.90	6.99	C	0.19	No	
H06-M01C	14.26	10/23/2018	312454.21	210308.15	9.21	C	-5.05	Yes	
H07-M01C	15.61	10/23/2018	313025.61	210472.30	10.34	C	-5.27	Yes	
H10-M02C	11.85	10/23/2018	313902.68	210348.69	6.81	C	-5.04	Yes	
H13-M01C	14.75	10/23/2018	315142.03	210300.57	10.55	C	-4.20	Yes	
H16-M01B	8.04	10/23/2018	316547.05	210339.92	6.19	C	-1.85	Yes	
I05-M01C	14.13	10/23/2018	312029.39	210577.26	9.93	C	-4.20	Yes	
I15-M01C	9.79	10/23/2018	315933.55	210787.74	7.96	C	-1.83	Yes	
J05-M01B	11.78	10/23/2018	311857.69	210939.78	8.08	C	-3.70	No	

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
J07-M01C	15.80	10/23/2018	312633.48	211190.21	11.33	C	-4.47	Yes	
K06-M01C	15.90	10/23/2018	312242.48	211381.69	10.63	C	-5.27	No	
K08-M01C	17.09	10/23/2018	313312.98	211360.33	12.65	C	-4.44	Yes	
K11-M01C	13.60	10/23/2018	314378.41	211410.84	8.54	C	-5.06	Yes	
K12-M01C	2.40	10/23/2018	314868.72	211353.58	4.20	C	1.80	No	
K13-M01C	14.01	10/23/2018	315285.40	211435.85	5.50	C	-8.51	Yes	
K17-M01C	6.38	10/23/2018	316652.90	211543.44	1.91	C	-4.47	Yes	
L07-M01C	16.00	10/23/2018	312628.80	211782.22	11.83	C	-4.17	Yes	
L19-M01C	13.22	10/23/2018	317406.16	211756.52	10.37	C	-2.85	Yes	
M09-M01C	20.84	10/23/2018	313452.71	212288.47	17.10	C	-3.74	Yes	
M10-M01C	19.01	10/23/2018	314072.21	212128.58	14.78	C	-4.23	Yes	
M12-M01C	20.11	10/23/2018	314937.24	212293.32	8.94	C	-11.17	Yes	
M14-M01C	21.30	10/23/2018	315399.39	212423.76	6.87	C	-14.43	Yes	
M15-M01C	10.20	10/23/2018	315995.33	212383.49	2.01	C	-8.19	Yes	
M22-M01B	9.27	10/23/2018	318767.02	212303.70	9.36	C	0.09	Yes	
N04-M01C	8.25	10/23/2018	311555.48	212529.40	6.60	C	-1.65	Yes	
N05-M01C	13.56	10/23/2018	312046.87	212542.82	10.93	C	-2.63	Yes	
N08-M01C	7.77	10/23/2018	313104.06	212761.71	5.40	C	-2.37	Yes	
O05-M01C	10.31	10/23/2018	312010.86	212919.79	8.47	C	-1.84	Yes	
O08-M01C	14.88	10/23/2018	313370.82	212852.59	11.71	C	-3.17	Yes	
O12-M02C	14.56	10/23/2018	314827.24	213059.49	12.44	C	-2.12	Yes	
P06-M02C	6.30	10/23/2018	312328.43	213450.14	4.78	C	-1.52	Yes	
P08-M01C	11.47	10/23/2018	313186.32	213591.15	9.29	C	-2.18	Yes	
P11-M01C	15.42	10/23/2018	314244.53	213495.50	12.94	C	-2.48	Yes	
P15-M01C	5.25	10/23/2018	315903.21	213405.46	1.52	C	-3.73	Yes	
P29-M01B	9.25	10/23/2018	321369.07	213668.38	9.39	C	0.14	Yes	
Q13-M01C	NM	10/23/2018	315150.18	213826.90	6.20	C	NM	Yes	
Q13-R01C	NM	10/23/2018	314980.06	213785.95	11.06	C	NM	Yes	Pumping well offline
Q26-P01C	NM	10/23/2018	320275.94	213928.21	6.27	C	NM	Yes	
R08-M01C	8.09	10/23/2018	313000.22	214110.09	7.33	C	-0.76	Yes	
R09-M02C	5.71	10/23/2018	313354.83	214326.59	4.91	C	-0.80	Yes	
R09-R02C	6.00	10/23/2018	313392.17	214242.20	4.47	C	-1.53	Yes	Pumping well offline
R10-M01C	NM	10/23/2018	313791.74	214193.39	10.14	C	NM	Yes	
R13-M01B	8.21	10/23/2018	315076.62	214336.63	6.65	C	-1.56	Yes	
R15-M01B	9.72	10/23/2018	315988.75	214377.10	8.10	C	-1.62	Yes	
R19-M01C	8.80	10/23/2018	317640.33	214339.20	3.78	C	-5.02	No	
S09-M01C	10.25	10/23/2018	313740.29	214463.82	9.20	C	-1.05	Yes	
S11-M01C	14.15	10/23/2018	314226.45	214637.79	8.55	C	-5.60	No	
S23-P01B	3.34	10/23/2018	318985.66	214755.38	2.31	C	-1.03	Yes	
S32-M02B	6.44	10/23/2018	322566.22	214852.93	6.62	C	0.18	Yes	
T29-M01B	2.62	10/23/2018	321733.89	215106.34	2.20	C	-0.42	Yes	
U08-M01C	5.50	10/23/2018	313308.70	215319.93	4.75	C	-0.75	Yes	
U12-M01B	3.30	10/23/2018	314803.86	215312.65	2.17	C	-1.13	Yes	
U14-M01B	7.90	10/23/2018	315410.28	215423.66	6.62	C	-1.28	Yes	
W16-M01B	2.30	10/23/2018	316186.00	216211.59	1.56	C	-0.74	Yes	
X26-M01B	2.91	10/23/2018	320163.99	216799.03	2.73	C	-0.18	Yes	
Y31-M01B	7.38	10/23/2018	322290.51	217230.98	7.69	C	0.31	Yes	

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
Z20-M01C	11.03	10/23/2018	317917.80	217657.89	10.52	C	-0.51	Yes	
Z28-M01B	4.95	10/23/2018	321127.64	217578.11	5.26	C	0.31	Yes	
H11-R01CD	10.84	10/23/2018	314339.37	210180.22	7.93	CD	-2.91	Yes	To bottom pump mount/ top I beam
K02-W01CD	13.50	10/23/2018	310842.54	211632.86	9.29	CD	-4.21	Yes	Pumping well offline
K06-R02CD	53.89	10/23/2018	312174.90	211382.38	10.39	CD	-43.50	Yes	200 GPM
M14-R02CD	36.40	10/23/2018	315450.37	212445.23	5.59	CD	-30.81	Yes	400 GPM
AA22-M01B	7.24	10/23/2018	318855.84	217857.16	6.81	D	-0.43	Yes	
AA25-M01C	3.81	10/23/2018	319843.99	217805.47	4.14	D	0.33	Yes	
C06-M01D	14.19	10/23/2018	312538.71	208064.57	9.34	D	-4.85	Yes	
C11-M02D	8.70	10/23/2018	314438.05	208215.01	5.63	D	-3.07	Yes	
D15-M01D	4.60	10/23/2018	315857.90	208732.19	5.22	D	0.62	Yes	
E14-M01D	8.45	10/23/2018	315627.33	209044.22	7.35	D	-1.10	Yes	
F07-M01D	12.14	10/23/2018	312701.81	209316.74	7.43	D	-4.71	Yes	
F09-M01D	13.55	10/23/2018	313404.74	209263.66	8.78	D	-4.77	Yes	
G08-R01D	13.57	10/23/2018	313254.73	209924.87	8.49	D	-5.08	Yes	Pumping well offline
G12-M01D	NM	10/23/2018	314607.48	209805.11	4.89	D	NM	Yes	
H07-M01D	6.85	10/23/2018	313020.86	210474.13	10.23	D	3.38	No	
H10-M01C	11.69	10/23/2018	313902.25	210353.64	6.80	D	-4.89	Yes	
H14-M01C	12.78	10/23/2018	315640.06	210112.15	8.33	D	-4.45	Yes	
H15-M01C	9.86	10/23/2018	315949.85	210368.61	7.52	D	-2.34	Yes	
H17-M01C	11.00	10/23/2018	316721.67	210423.80	8.43	D	-2.57	Yes	
I15-M01D	12.41	10/23/2018	315930.03	210783.44	8.02	D	-4.39	Yes	
J05-M01C	9.41	10/23/2018	311855.79	210946.99	8.11	D	-1.30	No	
J07-M01D	15.57	10/23/2018	312642.87	211198.93	11.04	D	-4.53	Yes	
K08-M01D	17.44	10/23/2018	313306.59	211348.44	12.86	D	-4.58	Yes	
K12-M01D	8.59	10/23/2018	314867.54	211348.23	3.65	D	-4.94	Yes	
L05-M01D	16.79	10/23/2018	312040.55	211967.66	12.57	D	-4.22	Yes	
L07-M01D	16.23	10/23/2018	312627.58	211795.72	11.89	D	-4.34	Yes	
L09-M01D	17.47	10/23/2018	313670.12	211901.42	12.96	D	-4.51	Yes	
M09-M01D	21.49	10/23/2018	313456.33	212282.73	17.43	D	-4.06	Yes	
M22-M01C	10.48	10/23/2018	318754.45	212297.72	9.20	D	-1.28	Yes	
N04-M01D	11.25	10/23/2018	311560.93	212531.98	7.23	D	-4.02	Yes	
N05-M01D	14.97	10/23/2018	312038.01	212536.16	10.97	D	-4.00	Yes	
N08-M01D	8.03	10/23/2018	313099.15	212761.69	5.19	D	-2.84	Yes	
O05-M01D	10.02	10/23/2018	312006.87	212914.48	8.08	D	-1.94	Yes	
O11-M01D	20.01	10/23/2018	314312.74	212885.78	15.46	D	-4.55	Yes	
O12-M02D	17.66	10/23/2018	314825.06	213049.16	10.82	D	-6.84	Yes	
O26-M01C	8.58	10/23/2018	320166.54	213028.63	7.81	D	-0.77	Yes	
P06-M01D	8.31	10/23/2018	312335.60	213404.19	4.83	D	-3.48	Yes	
P08-M01D	11.34	10/23/2018	313174.42	213583.05	8.94	D	-2.40	Yes	
Q08-M01D	7.65	10/23/2018	312973.50	214032.54	5.44	D	-2.21	Yes	
Q13-M01D	9.54	10/23/2018	315151.27	213823.03	7.65	D	-1.89	Yes	
Q13-R01D	NM	10/23/2018	314983.13	213769.78	10.68	D	NM	Yes	Pumping well offline
Q17-W01D	7.60	10/23/2018	316668.64	213942.50	5.16	D	-2.44	Yes	
Q20-M01C	3.43	10/23/2018	317777.85	213714.20	1.67	D	-1.76	Yes	
Q24-P01C	7.11	10/23/2018	319488.33	214061.33	5.84	D	-1.27	Yes	
Q30-M02C	8.99	10/23/2018	321859.65	213917.88	8.45	D	-0.54	Yes	

Appendix B
Water Levels - October 2018
Second Semester 2018 Semi-Annual NJPDES-DGW Report
Chambers Works Complex
Deepwater, New Jersey

Well ID	DTW	Date	Northing	Easting	TOC NAVD88	Aquifer	NAVD88 Elev	Mapped	Comments
R08-M01D	8.54	10/23/2018	312995.97	214105.70	7.26	D	-1.28	Yes	
S09-M01D	11.45	10/23/2018	313736.54	214460.89	9.42	D	-2.03	Yes	
S11-M01D	14.07	10/23/2018	314223.20	214635.96	8.47	D	-5.60	No	
S26-P01C	3.69	10/23/2018	320262.14	214802.68	2.51	D	-1.18	Yes	
S32-M02C	7.07	10/23/2018	322578.26	214856.22	6.19	D	-0.88	Yes	
T22-M01C	8.00	10/23/2018	318679.53	214923.05	6.73	D	-1.27	Yes	
T28-M01C	2.65	10/23/2018	321292.71	215020.88	2.29	D	-0.36	Yes	
U08-M01D	6.20	10/23/2018	313312.32	215317.28	4.81	D	-1.39	Yes	
U12-M01C	3.25	10/23/2018	314797.14	215305.48	1.94	D	-1.31	Yes	
W16-M01C	2.36	10/23/2018	316214.65	216199.03	1.66	D	-0.70	Yes	
X26-M01C	3.07	10/23/2018	320173.41	216792.62	2.70	D	-0.37	Yes	
Y31-M01C	6.75	10/23/2018	322282.79	217224.56	7.23	D	0.48	Yes	
AA22-M01C	6.76	10/23/2018	318845.66	217855.24	6.85	E	0.09	Yes	
C11-M01E	23.41	10/23/2018	314417.02	208213.28	6.35	E	-17.06	Yes	
G04-M01E	52.25	10/23/2018	311666.37	209760.16	8.15	E	-44.10	Yes	
H05-M04E	50.26	10/23/2018	311970.53	210108.56	5.51	E	-44.75	Yes	
J05-W01E	91.68	10/23/2018	311827.13	210993.33	10.65	E	-81.03	Yes	210 GPM
L19-M01D	NM	10/23/2018	317408.95	211750.29	10.29	E	NM	Yes	
L19-M01E	29.22	10/23/2018	317469.43	211746.40	13.97	E	-15.25	Yes	
N05-M01E	55.00	10/23/2018	312034.08	212565.18	10.03	E	-44.97	Yes	
P06-M01E	48.90	10/23/2018	312369.10	213441.00	4.69	E	-44.21	Yes	
R10-M01E	49.81	10/23/2018	313802.45	214207.26	10.55	E	-39.26	Yes	
R15-W01E	27.30	10/23/2018	315814.99	214354.84	8.31	E	-18.99	Yes	Pumping well offline
S32-M01D	10.07	10/23/2018	322632.04	214596.69	6.28	E	-3.79	Yes	
T29-M01E	18.70	10/23/2018	321458.36	214927.53	6.37	E	-12.33	Yes	
V21-W01E	18.82	10/23/2018	318134.58	215900.80	7.12	E	-11.70	Yes	
K09-M01F	39.99	10/23/2018	313632.58	211521.64	8.61	F	-31.38	Yes	
P11-M01F	39.67	10/23/2018	314252.35	213531.30	11.96	F	-27.71	Yes	
DE River	14.04	10/23/2018	315365.09	208022.32	--	MMA	0.14	Yes	Delaware River Moving Mean Average

Appendix C

Contour Map Reporting Forms

Appendix C

Contour Map Reporting Form – Figure 4 (A Zone)
Chambers Works Second Semester 2018 Semi-Annual NJPDES-DGW Report

This reporting form shall accompany each groundwater contour map submittal. Use additional sheets as necessary.

1. Did any surveyed well casing elevations change from the previous sampling event?

   Yes ________ No __X__

   If yes, attach new "Well Certification – Form B – Location Certification" as found in the "Guide for the Submission of Remedial Action Workplans" (NJDEP, March 1995) and identify the reason for the elevation change (damage to casing, installation of recovery system in monitoring well, etc.).

2. Are there any monitor wells in unconfined aquifers in which the water table elevation is higher than the top of the well screen?

   Yes __X__ No ________ If yes, identify these wells.

   The A zone is unconfined.

3. Are there any monitor wells present at the site but omitted from the contour map?

   Yes __X__ No ________

   Unless the omission of the well(s) has been previously approved by the Department, justify the omissions.

   Contour maps are only generated for the A zone wells listed in Table 3 of the Ground Water Remediation and RCRA Post Closure Plan for NJPDES-DGW Permit No. NJ0083429.

4. Are there any monitor wells containing separate phase product during this measuring event?

   Yes ________ No __X__

   Were any of the monitor wells with separate phase product included in the groundwater contour map?

   Yes ________ No __X__

   If yes, show the formula used to correct the water table elevation.

5. Has the groundwater flow direction changed more than 45 degrees from the previous groundwater contour map?

   Yes ________ No ___X___

   If yes, discuss the reasons for the change.

   ____

6. Has groundwater mounding and/or depressions been identified in the groundwater contour map?

   Yes ___X___ No ________

   Unless the groundwater mounds and/or depressions are caused by the groundwater remediation system, discuss the reasons for this occurrence.

   Groundwater mounding occurs landward of the slurry wall and sheet pile wall (shown in Figure 4 in the current DGW Report).

7. Are the wells used in the contour map screened in the same water-bearing zone?

   Yes ___X___ No ________

   If no, justify the inclusion of those wells.

   ____

8. Were the groundwater contours:

   Computer Generated ______

   Computer Aided ______

   Hand-Drawn ___X___

   If computer generated or aided, identify the interpolation method(s) used.

   ____

Appendix C

Contour Map Reporting Form – Figure 5 (B Aquifer)

Chambers Works Second Semester 2018 Semi-Annual NJPDES-DGW Report

This reporting form shall accompany each groundwater contour map submittal. Use additional sheets as necessary.

1. Did any surveyed well casing elevations change from the previous sampling event?

   Yes ________ No __X__

   If yes, attach new "Well Certification – Form B – Location Certification" as found in the "Guide for the Submission of Remedial Action Workplans" (NJDEP, March 1995) and identify the reason for the elevation change (damage to casing, installation of recovery system in monitoring well, etc.).

2. Are there any monitor wells in unconfined aquifers in which the water table elevation is higher than the top of the well screen?

   Yes __X__ No ________ If yes, identify these wells.

   The B aquifer is unconfined.

3. Are there any monitor wells present at the site but omitted from the contour map?

   Yes __X__ No ________

   Unless the omission of the well(s) has been previously approved by the Department, justify the omissions.

   Figure 5 (B Aquifer map) presents anomalous water-level data as purple well symbols. Anomalous data were noted for monitoring wells D11-M01B, J05-M02B, I12-M02B, and O21-M01B.

4. Are there any monitor wells containing separate phase product during this measuring event?

   Yes __X__ No ________

   Were any of the monitor wells with separate phase product included in the groundwater contour map?

   Yes __X__ No ________

   If yes, show the formula used to correct the water table elevation.

   No corrections to water-level measurements are necessary because the separate phase product detected was DNAPL. NAPL is inspected monthly under the NAPL Program. The NAPL Program is reported semi-annually and is part of this semi-annual DGW Report.

5. Has the groundwater flow direction changed more than 45 degrees from the previous groundwater contour map?

   Yes ________ No ___X___

   If yes, discuss the reasons for the change.

6. Has groundwater mounding and/or depressions been identified in the groundwater contour map?

   Yes ___X___ No ________

   Unless the groundwater mounds and/or depressions are caused by the groundwater remediation system, discuss the reasons for this occurrence.

   Interceptor Well System – controls the majority of B aquifer groundwater flow towards the site. The Corrective Action pumping wells control the B aquifer groundwater flow at the C Landfill.

7. Are the wells used in the contour map screened in the same water-bearing zone?

   Yes ___X___ No ________

   If no, justify the inclusion of those wells.

8. Were the groundwater contours:

   Computer Generated ______

   Computer Aided ___X___

   Hand-Drawn ______

   If computer generated or aided, identify the interpolation method(s) used.

   ArcGIS (version 2010) with kriging and hand smoothing of contour lines.

Appendix C

Contour Map Reporting Form – Figure 6 (C Aquifer)
Chambers Works Second Semester 2018 Semi-Annual NJPDES-DGW Report

This reporting form shall accompany each groundwater contour map submittal. Use additional sheets as necessary.

1. Did any surveyed well casing elevations change from the previous sampling event?

   Yes ________ No ___X___

   If yes, attach new "Well Certification – Form B – Location Certification" as found in the "Guide for the Submission of Remedial Action Workplans" (NJDEP, March 1995) and identify the reason for the elevation change (damage to casing, installation of recovery system in monitoring well, etc.).

2. Are there any monitor wells in unconfined aquifers in which the water table elevation is higher than the top of the well screen?

   Yes ________ No ___X___ If yes, identify these wells.

   The C and D aquifers are semi-confined.

3. Are there any monitor wells present at the site but omitted from the contour map?

   Yes ___X___ No ________

   Unless the omission of the well(s) has been previously approved by the Department, justify the omissions.

   Figure 6 (C Aquifer Map) presents anomalous water-level data as purple well symbols. Anomalous data were noted for monitoring wells H04-M01B, J05-M01B, K06-M01C, K12-M01C, R19-M01C, and S11-M01C.

4. Are there any monitor wells containing separate phase product during this measuring event?

   Yes ________ No ___X___

   Were any of the monitor wells with separate phase product included in the groundwater contour map?

   Yes ________ No ___X___

   If yes, show the formula used to correct the water table elevation.

5. Has the groundwater flow direction changed more than 45 degrees from the previous groundwater contour map?

   Yes ________ No ___X___

   If yes, discuss the reasons for the change.

6. Has groundwater mounding and/or depressions been identified in the groundwater contour map?

   Yes ___X___ No _______

   Unless the groundwater mounds and/or depressions are caused by the groundwater remediation system, discuss the reasons for this occurrence.

   Interceptor Well System – controls site groundwater so that flow is toward the site.

7. Are the wells used in the contour map screened in the same water-bearing zone?

   Yes _______ No ___X___

   If no, justify the inclusion of those wells.

   M14-R02CD and K06-R02CD are pumping wells that are screened in both the C and D aquifers.

8. Were the groundwater contours:

   Computer Generated _______

   Computer Aided ___X___

   Hand-Drawn _______

   If computer generated or aided, identify the interpolation method(s) used.

   ArcGIS (version 2010) with kriging and hand smoothing of contour lines.

Appendix C

Contour Map Reporting Form – Figure 7 (D Aquifer)
Chambers Works Second Semester 2018 Semi-Annual NJPDES-DGW Report

This reporting form shall accompany each groundwater contour map submittal. Use additional sheets as necessary.

1. Did any surveyed well casing elevations change from the previous sampling event?

   Yes ________ No ___X___

   If yes, attach new "Well Certification – Form B – Location Certification" as found in the "Guide for the Submission of Remedial Action Workplans" (NJDEP, March 1995) and identify the reason for the elevation change (damage to casing, installation of recovery system in monitoring well, etc.).

2. Are there any monitor wells in unconfined aquifers in which the water table elevation is higher than the top of the well screen?

   Yes ________ No ___X___ If yes, identify these wells.

   The C and D aquifers are semi-confined.

3. Are there any monitor wells present at the site but omitted from the contour map?

   Yes ___X___ No ________

   Unless the omission of the well(s) has been previously approved by the Department, justify the omissions.

   Figure 7 (D Aquifer map) presents anomalous water-level data as purple well symbols. Anomalous data were noted for monitoring well H07-M01D, J05-M01C and S11-M01D.

4. Are there any monitor wells containing separate phase product during this measuring event?

   Yes ________ No ___X___

   Were any of the monitor wells with separate phase product included in the groundwater contour map?

   Yes ________ No ___X___

   If yes, show the formula used to correct the water table elevation.

5. Has the groundwater flow direction changed more than 45 degrees from the previous groundwater contour map?

   Yes ________ No ___X___

   If yes, discuss the reasons for the change.

6. Has groundwater mounding and/or depressions been identified in the groundwater contour map?

   Yes ___X___ No _______

   Unless the groundwater mounds and/or depressions are caused by the groundwater remediation system, discuss the reasons for this occurrence.

   Interceptor Well System – controls site groundwater so that flow is toward the site.

7. Are the wells used in the contour map screened in the same water-bearing zone?

   Yes _______ No ___X___

   If no, justify the inclusion of those wells.

   M14-R02CD and K06-R02CD are pumping wells that are screened in both the C and D aquifers.

8. Were the groundwater contours:

   Computer Generated _____

   Computer Aided ___X___

   Hand-Drawn _____

   If computer generated or aided, identify the interpolation method(s) used.

   ArcGIS (version 2010) with kriging and hand smoothing of contour lines.

Appendix C

Contour Map Reporting Form – Figure 8 (E Aquifer)

Chambers Works Second Semester 2018 Semi-Annual NJPDES-DGW Report

This reporting form shall accompany each groundwater contour map submittal. Use additional sheets as necessary.

1. Did any surveyed well casing elevations change from the previous sampling event?

   Yes _________ No __X__

   If yes, attach new "Well Certification – Form B – Location Certification" as found in the "Guide for the Submission of Remedial Action Workplans" (NJDEP, March 1995) and identify the reason for the elevation change (damage to casing, installation of recovery system in monitoring well, etc.).

2. Are there any monitor wells in unconfined aquifers in which the water table elevation is higher than the top of the well screen?

   Yes _________ No __X__ If yes, identify these wells.

   The E aquifer is a confined aquifer.

3. Are there any monitor wells present at the site but omitted from the contour map?

   Yes _________ No __X__

   Unless the omission of the well(s) has been previously approved by the Department, justify the omissions.

   Contour maps are only generated for the E Aquifer wells listed in Table 3 of the Ground Water Remediation and RCRA Post Closure Plan for NJPDES-DGW Permit No NJ0083429.

4. Are there any monitor wells containing separate phase product during this measuring event?

   Yes _________ No __X__

   Were any of the monitor wells with separate phase product included in the groundwater contour map?

   Yes _________ No __X__

   If yes, show the formula used to correct the water table elevation.

5. Has the groundwater flow direction changed more than 45 degrees from the previous groundwater contour map?

   Yes _________ No __X__

   If yes, discuss the reasons for the change.

6. Has groundwater mounding and/or depressions been identified in the groundwater contour map?

   Yes ________ No ___X___

   Unless the groundwater mounds and/or depressions are caused by the groundwater remediation system, discuss the reasons for this occurrence.

   ____

   ____

   ____

7. Are the wells used in the contour map screened in the same water-bearing zone?

   Yes ___X___ No ________

   If no, justify the inclusion of those wells.

   ____

   ____

   ____

8. Were the groundwater contours:

   Computer Generated ______

   Computer Aided ___X___

   Hand-Drawn ______

   If computer generated or aided, identify the interpolation method(s) used.

   ArcGIS (version 2010) with kriging and hand smoothing of contour lines.

   ____

   ____

Appendix D

Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report, AECOM, April 2019

AECOM

Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report

Chemours Chambers Works
Deepwater, New Jersey

Submitted on behalf of:
The Chemours Company

Submitted by:
AECOM
Sabre Building
Suite 300
4051 Ogletown Road
Newark, DE 19713

Project Number: 60593793.19003
Date: April 2019

Table of Contents

List of Tables

Acronym List

Acronym	Explanation
CFR	Code of Federal Regulations
CRG	Corporate Remediation Group
DGW	Discharge to Groundwater
DQO	Data Quality Objective
DVM	Data Verification Module
EPA	U.S. Environmental Protection Agency
FB	Field Blank
HASP	Health and Safety Plan
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
MB	Method Blank
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
PQL	Practical Quantitation Limit
PSA	Project Safety Analysis
QA	Quality Assurance
QC	Quality Control
REP	Replicate. A duplicate field sample.
RPD	Relative Percent Difference
RPR	Relative Percent Recovery
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TAL	Target Analyte List
TB	Trip Blank
TCL	Target Compound List
TIC	Tentatively Identified Compound
TOC	Total Organic Carbon
TOX	Total Organic Halogen
VOA	Volatile Organic Analyte
WP	Water Pollution Proficiency Study, a performance evaluation program

Executive Summary

The quality assurance (QA) program for the Chemours Chambers Works New Jersey Pollutant Discharge Elimination System-Discharge to Groundwater (NJPDES-DGW) Permit is outlined in the Chambers Works Sampling and Analysis Plan, which is incorporated by reference in the Chambers Works NJPDES-DGW Permits NJ0083429 and NJ0105872. The current permits require submission of a semi-annual report detailing the QA activities. This report is submitted to meet those requirements.

The QA activities during the second semester of 2018 for the Chambers Works NJPDES-DGW Permit included a determination of the completeness of results; an evaluation of analytical data and field quality control (QC) samples using a performance audit process to objectively measure laboratory and field QC data characteristics; and an evaluation of actual field sampling procedures by means of detailed on-site audit. An overview of the findings from these initiatives is provided in this executive summary. Further details are included in the report.

The overall performance survey determined that sampling was done for 100% of the required locations for the second semester of 2018, and 100% of the analytical tests were performed as scheduled.

Data quality objectives were quantitatively and qualitatively benchmarked in terms of the data characteristics of accuracy, precision, representativeness, and completeness. Data evaluation was accomplished by conducting field and laboratory performance audits using the guidance provided in New Jersey Department of Environmental Protection (NJDEP) QA data validation standard operating procedures. Data qualifiers were assigned when data quality objectives were not met. A sample analysis was said to be complete when the well was sampled and no data were rejected based on data evaluation. A total of 100% of the required analytical results was determined to be complete. This performance level exceeds the data quality objectives.

A detailed field system audit was conducted at the Chambers Works Complex on July 25, 2018. The results of this audit indicated that the procedures and processes followed by the site field operations team were in compliance with the Chambers Works standard operating procedures and the NJDEP field sampling guidance documents. Training records were reviewed and found to be up-to-date.

A laboratory system audit of Eurofins Lancaster Laboratories, Inc. (Lancaster), the laboratory that performed the majority of the analytical work for the period, was completed in October 2014. The purpose of this audit was to establish that the work performed by the laboratory was in compliance with its standard operating procedures and with the analytical methods required by the permit. The audit indicated that the laboratory procedures consistently provide usable high-quality results needed to demonstrate regulatory compliance and to rely on for decision-making processes.

1.0 Introduction

This report details the quality assurance (QA) activities for the Chambers Works New Jersey Pollutant Discharge Elimination System – Discharge to Groundwater (NJPDES-DGW) permits NJ0083429 and NJ0105872 for the period from July 1 through December 31, 2018. The QA report is submitted in compliance with the annual QA reporting requirements outlined in the Chambers Works Quality Assurance Project Plan/Sampling and Analysis Plan For Groundwater and Leachate Monitoring (October 2010).

This report defines the data quality objectives for the project, describes the results of field and laboratory performance audits, reviews the results of the field system audit, and makes recommendations regarding any corrective action for field procedures.

2.0 Data Quality Objectives

Data Quality Objectives (DQOs) are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental measurements. The uncertainty for sample parameter results may arise from a combination of factors, including sampling procedures, sample matrix characteristics, inhomogeneity of samples, and the inherent accuracy and precision limitations of analysis methods. DQOs are quantitatively and qualitatively described in terms of data characteristics, which include precision, accuracy, representativeness, completeness, and comparability.

This section details the data qualifiers applied and quality control (QC) summary information (completeness, representativeness, accuracy, and precision) and uses the data evaluation guidance provided in the New Jersey Department of Environmental Protection (NJDEP) documents Quality Assurance Data Validation of Analytical Deliverables-Target Compound List (TCL)-Organics [Standard Operating Procedure (SOP) No. 5.A.13] and Quality Assurance Data Validation of Analytical Deliverables-Target Analyte List (TAL)-Inorganics (SOP No. 5.A.02).

The data QA objectives are as follows: precision, accuracy, representativeness, comparability, and completeness.

2.1 Precision

Precision is defined as the agreement between numeric values for two or more measurements, which have been made in an identical fashion.

The laboratory objective for precision was equal to or exceeded the guidelines of the analytical methods. The laboratory routinely monitored precision for each of the methods by means of relative percent difference (RPD) measurements for laboratory control spike (LCS) and laboratory control spike duplicate (LCSD); matrix spike (MS) samples and matrix spike sample duplicates (MSD); or samples and sample duplicates/replicates (REPs) in each analytical batch. For example, if replicate sample analyses for a particular inorganic analyte fall outside the established acceptance criteria, the results for that analyte in all samples in the batch are flagged as quantitatively estimated (J).

The precision for the project was 99.6%. The objective was to achieve a minimum of 75% of analytical results, which met or exceeded the guidelines in the most recent NJDEP data validation guidelines (referenced above) for sample replicate acceptance criteria.

2.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted true value. The laboratory objective for accuracy was to equal or exceed the requirements of the analytical methods. The laboratory routinely monitored accuracy for the methods by means of MS and LCS recovery results in each analytical batch. For example, if the result for a given analyte in an unspiked sample [volatile organic analyte (VOA)] was greater than the practical quantitation limit (PQL) and the relative percent recovery (RPR) was zero for the given analyte in the MS sample, then the result for that analyte in the unspiked sample was flagged as quantitatively estimated (J).

The accuracy for the project was 92.2%. The objective was to achieve a minimum of 75% of analytical results, which met or exceeded the guidelines in the most recent NJDEP data validation guidelines for MS recovery acceptance criteria.

2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a selected characteristic of a population, parameter variations at the sample point, a process condition, or an environmental condition.

The representativeness of the data from various sampling sites depends upon the procedures used in processing the samples. This process included field sampling procedures; shipping conditions, containers, and preservatives; and handling samples at the laboratory. The objective was to conduct the sampling events, shipments of samples, and analyses of samples without introducing bias or imprecision in the analytical results. Representativeness was monitored by reviewing results of method blanks (MB), trip blanks (TB), and equipment or field blanks (FB); it was also ensured by performing all analyses within the method specific hold times. For example, if a trip blank showed low-level contamination for Total Organic Halogen (TOX) or VOA, then associated field sample results less than five times that in the trip blank (10 times for common laboratory VOA contaminants) were flagged as biased high (B). Results that were flagged with a B may represent false positives.

The representativeness for the project was 99.0%. The objective was to achieve a minimum of 75% of analytical results, which met or exceeded the guidelines in the most recent NJDEP data validation guidelines for blank acceptance criteria.

2.4 Comparability

Comparability expresses consistency in sampling and analytical procedures so that one data set can be compared to another.

The comparability of the data with previous studies was ensured by consistently following specific practices, protocols, and methodologies for field and laboratory operations. Field sampling, preservation, and shipment procedures were done according to requirements outlined in the NJDEP Field Sampling Procedures Manual (June 2005) and the Chambers Works Quality Assurance Project Plan with Sampling and Analysis Plan for Groundwater and Leachate Monitoring (October 2010).

The laboratory was required to comply with the appropriate methodologies specified for the project. These included methods listed in Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW846 3rd Ed., and approved methods listed in 40 Code of Federal Regulations (CFR) 136.3. The laboratory objectives for comparability include use of standard methodology, following an established QA/QC, use of traceable calibration standards, and participation in a laboratory performance program.

2.5 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system compared with the amount that was expected under normal conditions.

Evaluating the accuracy, precision, and representativeness through a data review process assessed the completeness of the analytical results reported by the laboratory. A sample analysis was said to be complete, for the purposes of this report, if it was done as required and if the result was not rejected based on data evaluation.

The overall data quality for the project was 99.7%. The objective for the project was a minimum of 75% of reported analytical results classified as complete.

3.0 Data Evaluation Results

3.1 General Explanation

Data evaluation was accomplished by conducting a field performance audit and laboratory data performance audit. The field performance audit was used to evaluate sample representativeness as measured through field blank, trip blank, and field duplicate sample results. Additionally, chains of custody were reviewed to determine that the correct numbers of field and trip blank samples were submitted and that hold times were met. Data qualifiers were assigned as appropriate.

The field and laboratory performance audits were used to determine if the data quality objectives for precision, accuracy, representativeness, comparability, completeness, and usability were met. Data qualifiers were assigned when data quality objectives were not met. Field parameters such as pH, specific conductance, redox, dissolved oxygen, and temperature were not evaluated for accuracy, precision, and representativeness. These tests do not include quality control samples related to the data quality characteristics.

The laboratory performance audit consists of the Chemours In-House Review, performed on all data to evaluate data usability. The Data Verification Module (DVM) is as a series of data quality checks, which is a combination of software (Locus EIM™ database DVM) and manual reviewer evaluations, performed to determine if the data are usable. The automated program performs a series of checks on the laboratory data to evaluate the following:

- Field and laboratory blank contamination
- U.S. Environmental Protection Agency (EPA) hold time criteria
- Missing QC samples
- MS/MSD recoveries and the RPDs between these spikes
- LCS/LCSD recoveries and the RPD between these spikes
- Surrogate spike recoveries for organic analyses
- RPD between field duplicate sample pairs
- RPD between laboratory replicates for inorganic analyses
- Difference/percent difference between total and dissolved sample pairs

The DVM applies the following data qualifiers to analysis results, as warranted.

Qualifier	Definition
R	Unusable result. Analyte may or may not be present in the sample.
B	Not detected substantially above the level reported in the laboratory or field blanks.
J	Analyte present. Reported value may not be accurate or precise.
UJ	Not detected. Reporting limit may not be accurate or precise.

The laboratory may have applied one or more of the following data qualifiers to analysis results, as warranted.

Laboratory Qualifier	Definition
J	Estimated value; result falls between method detection limit (MDL) and practical quantitation limit (PQL).
U	Analyte was not detected at the specified reporting limit

These laboratory qualifiers are applied independent of DVM qualifiers.

Provided below is an explanation of each data qualifier and its relation to precision, accuracy, representativeness, comparability, completeness, and usability:

- The symbol "R" is used to flag test results as rejected. Results considered to be invalid due to method noncompliance issues, including very low spike recoveries, which may be due to sample matrix issues, would be rejected.
- The "B" flag is applied to qualify associated field sample data when the value of a given parameter in the sample was less than five times (ten times for common laboratory contaminants) the value of that parameter in the laboratory, field, or trip blank. In other words, the field sample result may be a false positive and was assumed to be due to the same source of contamination affecting the field/trip blank.
- The symbol "J" was used to flag certain results as "estimated" values. Non-detect results qualified "UJ" indicate that the analyte was not detected but that the associated reporting limit should be considered to be estimated. The data validation guidelines cited above indicate various scenarios when associated field sample results should be qualified as "estimated." These scenarios are generally not related to method compliance issues (calibrations, instrument performance checks, etc.) but are due to matrix-related issues. The "J" flagged results generally indicate usable data, which should be considered as quantitatively estimated. In other words, the results are not necessarily within the norms for accuracy and precision of the test method employed, but in the reviewer's judgment, are usable. Poor replicate reproducibility and poor spike recovery, and analyses performed within twice the applicable hold time are examples of when the "J" flag would be applied to associated data.

3.2 Summary of Field and Laboratory Performance Audits

Table 1 is a key to the use of symbols in Tables 2 through 7 as well as a reference for the multiple-analyte organics tests. The use of symbols has been described previously. Tables 2 through 7 summarize the results of both the laboratory and field performance audits for the second half of 2018. The tables are arranged by monitoring program to illustrate which wells and respective parameters are required to be sampled/analyzed during the second half of 2018. The symbol "T" in the tables indicates that the required monitoring action was accomplished (which implies that sampling and analyses were completed) according to the current Sampling and Analysis Plan (SAP). The symbol "NS" indicates that the permit required sampling and analysis during the timeframe, but this was not accomplished as scheduled. As a result, the tables provide a means to verify that all the scheduled wells were sampled and analyzed as required by the Chamber Works DGW Permit. After the completeness check was performed, the data review process described in previous sections was carried out, and data qualifiers were

applied to results as appropriate. Table 8 provides summary information on the individual data quality characteristics for each of the tests performed.

The QC summary tables enumerate the results of the laboratory and field performance audits for the Closure and Post-Closure for the A, B, and C Basins; Perimeter Monitoring; Secure C Landfill Corrective Action Monitoring; Secure C Landfill Detection Monitoring for Areas 2, 3, 4; Post-Closure Monitoring for RCRA Units, and; PFOA Monitoring Programs, respectively. Table 8 summarizes the calculated results for accuracy, precision, representativeness, and completeness for each test. As shown in Table 8, each of the data quality measures evaluated was greater than the 75% objective.

The laboratory performance audit results show that most qualifiers occurred due to problems with quality control batch matrix spike recovery or reproducibility. Qualification based on matrix quality control samples normally indicates a matrix effect within a given sample but does not indicate poor laboratory performance. Evaluation of laboratory control samples confirmed proper laboratory system performance, except as noted, indicating that the analyses were performed properly under "in control" conditions. The following table presents the numbers of analytes that were qualified.

Analyte	R Qualifier	B Qualifier	J Qualifier	UJ Qualifier
Semi-volatiles[1]	13	5	49	272
PCB Congeners		34	8	
PFCs[1]		2	2	1
Aluminum		1	2	
Arsenic			8	
Chloride			1	
Chromium			2	
Cyanide			2	3
Iron			2	
Lead, total			3	
Nickel			1	
TOC			3	
TOX	1	10	30	10
Zinc	1		2	

[1]Individual congeners or analytes are identified in the text that follows.

In accordance with Corporate Remediation Group (CRG) instructions to the laboratory, a sample from Chambers Works, as possible, was used to prepare the MS and MSDs for all batches of samples containing Chambers Works samples. A sample from one program may have been used to perform the QC evaluation of samples from other programs.

3.2.1 Semi-Volatiles

Non-detect reporting limits for the semi-volatile base/neutral compound benzidine in 13 Perimeter Monitoring Program samples were qualified R as unusable due to a very poor LCS or MS RPR.

Results for 1,2-dichlorobenzene and 1,4-dioxane in five additional Perimeter Monitoring Program samples were qualified B, and the results may be biased high, or may be false positives, due to comparable concentrations found in an associated equipment blank sample.

Results and non-detect reporting limits for one or more of the semi-volatile organic compounds 4-chloroaniline, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 3,3'-dichlorobenzidine, hexachlorobutadiene, o-toluidine, and 1,2,4 trichlorobenzene in five Secure C Landfill Corrective Action Monitoring Program samples, and 4-chloroaniline, bis(2-chloroisopropyl ether, 1,2-dichlorobenzene 1,3-dichlorobenzene, 1,4-dichlorobenzene, 3,3'-dichlorobenzidine, hexachlorobutadiene, 4-nitroaniline, o-toluidine, and 1,2,4 trichlorobenzene in six Secure C Landfill Detection Monitoring Program samples, were qualified as estimated, due to poor LCS or MS recoveries.

Non-detect reporting limits for the semi-volatile base/neutral compound o-toluidine in two additional Secure C Landfill Detection Monitoring Program samples were qualified as estimated, due to poor LCS recoveries

Results and non-detect reporting limits for one or more of the following semi-volatile compounds in forty-three Perimeter Monitoring Program samples were qualified as estimated and the reporting limits for the non-detect results may be higher than reported, due to an LCS or MS RPR below criteria:

Benzidine
bis(2-Chloroisopropyl)ether
bis(2-Ethylhexyl)phthalate
Butylbenzylphthalate
4-Chloroaniline
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
Diethylphthalate
Dimethylphthalate
Dioctylphthalate
Hexachlorobutadiene
Hexachlorocyclopentadiene
1-Naphthylamine
2-Naphthylamine
4-Nitroaniline
o-Toluidine
1,2,4-Trichlorobenzene

Results and non-detect reporting limits for 1,4-dioxane, analyzed by method 8270 single ion monitoring (SIM) isotope dilution, in 29 Perimeter Monitoring Program samples and three Secure C Landfill Corrective Action Monitoring Program samples were qualified as estimated, and the reporting limits for the non-detect results may be higher than reported, due to an exceedance of the laboratory preparation hold time. The result for acenaphthene in one Perimeter Monitoring Program sample was qualified as estimated due to a poor field duplicate precision.

3.2.2 PCBs

The results for PCB 18, PCB 30, PCB 43, PCB 45, PCB 48, PCB 51, PCB 64, and PCB 73 in one Post Closure Monitoring for RCRA Units Program sample were qualified J as estimated due to poor field duplicate precision.

Results for the following PCB congeners were qualified B, and the results may be biased high, or may be false positives, due to comparable concentrations found in an associated laboratory method blank or equipment blank sample:

PCB 37	PCB 85	PCB 129
PCB 44	PCB 86	PCB 138
PCB 47	PCB 87	PCB 147
PCB 56	PCB 97	PCB 149
PCB 60	PCB 199	PCB 153
PCB 65	PCB 105	PCB 160
PCB 66	PCB 109	PCB 163
PCB 68	PCB 116	PCB 168
PCB 77	PCB 117	PCB 180
PCB 82	PCB 119	PCB 183
PCB 83	PCB 125	PCB 193
PCB 84		

3.2.3 PFCs

The result for PFOSA in one PFOA Monitoring Program sample was qualified B, and the result may be biased high, or may be a false positive, due to a comparable concentration found in an associated equipment blank sample.

The result for PFHxA in one PFOA Monitoring Program sample, and the non-detect reporting limit for PFDoA in one additional PFOA Monitoring Program sample, were qualified as estimated and the reporting limit for the non-detect result may be higher than reported, due to a surrogate recovery below criteria.

The result for PFTeA in one PFOA Monitoring Program sample is qualified J as estimated due to poor field duplicate precision.

3.2.4 Aluminum

The result for aluminum in one Secure C Landfill Corrective Action Monitoring Program sample was qualified B, and the result may be biased high, or may be a false positive, due to a comparable concentration found in an associated laboratory method blank.

Results for aluminum in two Perimeter Monitoring Program samples were qualified J, as estimated, due to poor laboratory replicate precision.

3.2.5 Arsenic

Arsenic results in three Secure C Landfill Detection Monitoring Program samples and in five Perimeter Monitoring Program samples were qualified J as estimated, due to an MS RPR that exceeded criteria; the reported sample results may be biased high.

3.2.6 Chloride

A chloride result in one Secure C Landfill Detection Monitoring Program sample is qualified J as estimated due to poor field duplicate precision.

3.2.7 Chromium

The results for chromium in two Perimeter Monitoring Program samples were qualified J, as estimated, due to poor laboratory replicate precision.

3.2.8 Cyanide

Results and non-detect reporting limits for cyanide in five Secure C Landfill Corrective Action Monitoring Program samples were qualified as estimated, and the reporting limits for the non-detect results may be higher than reported, due to a poor MS RPR.

3.2.9 Iron

Iron results in two Perimeter Monitoring Program samples were qualified J, estimated, due to poor laboratory replicate precision.

3.2.10 Lead, total

Results for lead in three Secure C Landfill Detection Monitoring Program samples were qualified J as estimated, due to an MS RPR that exceeded criteria, and the reported sample results may be biased high.

3.2.11 Nickel

A result for nickel in one Perimeter Monitoring Program sample was qualified J, estimated, due to poor laboratory replicate precision

3.2.12 TOC

Results for TOC in two Secure C Landfill Detection Monitoring Program sample were qualified J as estimated, and the results may be biased high, due to an MS RPR above criteria. A result for TOC in one Perimeter Monitoring Program sample was qualified J, estimated, due to a poor MS RPR.

3.2.13 TOX

A non-detect reporting limit for TOX in one Perimeter Monitoring Program sample was qualified R as unusable, due to a very poor MS RPR.

TOX results for six samples from the Closure and Post-Closure Program, one sample from the Perimeter Monitoring Program, and three samples from the Secure C Landfill Corrective Action Monitoring Program were qualified B; the results may be biased high, or may be false positives, due to a comparable concentration found in an associated field equipment or trip blank sample.

The results for TOX in twenty-three Perimeter Monitoring Program samples, two Secure C Landfill Corrective Action Monitoring Program samples, and five Secure C Landfill Detection Monitoring Program samples were qualified J as estimated due to a poor or very poor MS recovery.

Non-detect results for TOX in nine samples from the Perimeter Monitoring Program and one sample from the Secure C Landfill Detection Monitoring Program were qualified UJ, and the reporting limits may be higher than reported, due to a poor or very poor MS recovery.

3.2.14 Zinc

A non-detect reporting limit for zinc in one Perimeter Monitoring Program sample was qualified R as unusable, due to a very poor MS RPR.

Zinc results in two additional Perimeter Monitoring Program samples were qualified J as estimated, due to an MS RPR that exceeded criteria; the reported sample results may be biased high.

Additional sample results from all programs where the result is between the method detection limit (MDL) and the practical quantitation limit (PQL) were qualified J by the laboratory and should be considered to be estimated. As well, sample results from all programs where the result is a tentatively identified compound (TIC) should be considered to be estimated values.

The field performance audit showed that 16 field blanks and 11 trip or travel blanks were analyzed as required.

3.3 Completeness Summary

The percentage of wells sampled and the associated tests performed as scheduled was 100%. The overall completeness, or the percentage of tests sampled, analyzed and reported without rejection, was greater than 99%.

3.4 Field Duplicate Summary

The purpose of field duplicate samples is to measure the overall precision of sampling and analysis. Duplicate samples were evaluated per analyte by comparing the field sample to the corresponding duplicate sample result. If both results were less than the detection limit, the duplicate sample for that analyte was considered to have passed the criteria for the purpose of this report. If one or both results were between one and five times the detection limit, the duplicate was considered to have met the criteria if the two results differed by less than the detection limit. If one result was less than the detection limit and the other was not, and if the two results differed by a value less than the detection limit, then the duplicate was said to have met the acceptance criteria. Finally, if both results were at least five times the detection limit, the duplicate was considered to have met the criteria if the relative percent difference (RPD) between the two results was less than or equal to 25%. (RPD is the absolute value of the difference of two measurements divided by their average).

Duplicate samples were taken at ten locations during the second half of 2018. This number is 9.8% of the total number of sampling locations during the period. The results of the evaluation of field duplicates are summarized by test in Table 9. The table presents only analytes that were analyzed as duplicates. The evaluation process indicated that 79.2% of the duplicate analyte results met the criteria described above.

3.5 Laboratory Performance Studies

Lancaster participates in performance evaluation studies. Blind samples are sent to the laboratory for analysis, and the results are compared to other laboratories across the country. Table 10 illustrates the three most recent proficiency sample performance evaluation results. Lancaster historically performed above the national average of 88-90% for the WP series and has scored better than 95% in the subsequent studies conducted, most recently, by Environmental Resource Associates.

4.0 Field System Audit Results

The field system audit is a systematic on-site qualitative review conducted to assess the implementation of the Chambers Works field QA program. A systems audit of the Chambers Works groundwater monitoring program was conducted on July 25, 2018. The audit focused on sampling activities at monitoring well G04-M01B and G04-M01E. The audit process as described in the Chambers Works Quality Assurance Project Plan/Sampling and Analysis Plan for Groundwater and Leachate Monitoring (October 2010) was used as guidance.

The field system audit included a review of QA, groundwater sampling and operational procedures, chain-of-custody procedures, equipment adequacy, training records, corrective actions, health and safety, and waste management.

On the whole, field activities were in compliance with Chambers Works QA program. For the sake of brevity, the audit report is summarized below to outline observed discrepancies and discuss associated corrective actions for improved future performance. The checklists used to augment the auditors' assessments of procedural compliance and quality are omitted.

4.1 Overall Knowledge of the Quality Assurance (QA) Program

The level of understanding of each individual sampling team member was assessed through observations and interaction during a field audit. They were asked about the QA program and corresponding responsibilities. It was established that the personnel clearly understood the program and responsibilities as related to the groundwater monitoring implementation.

4.2 Groundwater Sampling and Operation Procedures

The field audit was performed to determine if the Chambers Works groundwater sampling procedures standards were followed as outlined in the NJDEP Field Sampling Procedures Manual (June 2005) and the Chambers Works Quality Assurance Project Plan/Sampling and Analysis Plan For Groundwater and Leachate Monitoring (October 2010).

The audit showed that sample collection was conducted in accordance with the established quality standards as outlined in the documents referenced above. The following observations were made during the audit.

4.2.1 Instrument Calibration

The audit indicated that adequate calibration procedures were being followed. Field instruments (pH/temperature, redox, dissolved oxygen, and specific conductivity) were calibrated prior to the start of field activities. Documentation was appropriate.

During the field audit, blind standard solutions (pH/temperature and specific conductivity) were used to determine accuracy of the meters. Calibration checks were within acceptable accuracy limits.

4.2.2 Equipment Check

The goal of the equipment check was to confirm that the specified groundwater equipment was available and in working order.

Upon inspection, it was determined that the sampling team was properly equipped for groundwater monitoring. The equipment functioned properly and appeared to be in good condition.

4.2.3 Purging Activities

The field audit indicated that the sampling team members were following appropriate procedures for monitoring well purging.

4.2.4 Sample Collection Procedures

Sample collection procedures were adequate during the July 25, 2018 field audit.

Proper purging and sampling procedures were observed. The field team understood the need for good field notes and proper meter operation, both in their implementation and the potential to affect the integrity of the groundwater samples.

4.2.5 Field Documentation

The bound field logbook was checked for completeness, including site, location of sample, person(s) sampling, analytical, volume of samples, preservation, weather conditions, method of sampling, method of purging, volume purged, time sampled, date sampled, and any factors that might affect the sample quality. The field logbook was neat and found to be satisfactory.

4.2.6 Sample Vehicles

Inspection of the Chambers Works groundwater sampling vehicles indicated satisfactory performance and adequate housekeeping and organization.

4.2.7 Chain-of-Custody Procedures

Chain-of-custody procedures were reviewed to ensure that the appropriate documentation had been produced for sample tractability and integrity.

The chain-of-custody forms evaluated in the field were determined to ensure sample tractability and integrity. The chain-of-custody had all appropriate signatures.

4.3 Training

The goal of the audit process was to determine the level and current status of the groundwater sampling team personnel training at the time of the audit.

Personnel were aware of the required state protocols for groundwater sampling and operational procedures.

Personnel records were reviewed during the record audit, and a summary is included in Table 11. The sampling team training records demonstrated that the groundwater team had adequate training. Records indicated that personnel received the training required by law. Additional training has been provided as general site orientation, specific area orientation, daily instruction, staff meetings, and safety meetings. The health and safety plan, Project Safety Analysis (PSA), work plan, and waste management plan were also

reviewed. Additional training was completed when necessary. The monthly safety meetings are listed in Table 12.

The training records included documentation of the following:

- 29 CFR 1910.120 – Supervisory Training
- 29 CFR 1910.120 – 40-Hour Training
- 29 CFR 1910.1208 – 8-Hour Refresher Course
- Annual Respirator Fit Test, if necessary
- Monthly Safety Meeting

Review of the training records indicated that proper documentation of the sampling team was available and updated.

4.4 Records

The records audit determined that recordkeeping procedures are adequate.

4.5 Corrective Action

The goal of the corrective action audit was three-fold. The auditor determined if the field QA/QC sample results and field procedure requirements were being reviewed, if corrective action steps were being taken when necessary, and if the appropriate chain of command was being followed when responding to situations.

When operational procedures and sampling requirements do not meet project specifications, a corrective action is required. The corrective action process was reviewed during the field system audit. A corrective action can result from an unfavorable performance audit, or it can be initiated when field procedures and sampling requirements do not meet project specifications. Situations requiring a corrective action must be recorded and require an investigation of cause.

4.6 Health and Safety

A PSA was conducted prior to commencing the field activities. The health and safety audit was done to determine if the proper precautions, equipment, and training were being used to protect the team and work environment during field operations. Complacency, alertness, and awareness were discussed with field personnel.

The Chambers Works Health and Safety Plan for Routine Sampling Programs (HASP, December 2012) is reviewed on a regular basis by AECOM Health and Safety resources and field assessment personnel. The field-related systems audit reviewed the safety procedures, safety training, and safety records. Safety procedures, training, and records were determined to be adequate during the field audit.

4.7 Conclusions

The July 25, 2018 field system audit was performed to assess the implementation of the Chambers Works field QA program. Results of the audit indicated that the groundwater sampling team procedures comply with the NJDEP Field Sampling Procedures Manual (June 2005) and the Chambers Works Quality Assurance Project Plan/Sampling and Analysis Plan for Groundwater and Leachate Monitoring (October 2010).

Tables

Table 1
Key To QC Summary Tables
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

	Description
T	Test Complete
NS	Incomplete Test or Not Sampled
---	Test Not Required
J	Analyte present. Reported value may not be accurate or precise.
UJ	Not detected. Reporting limit may not be accurate or precise.
B	Not detected substantially above the level reported in the laboratory or field blanks.
R	Unusable result. Analyte may or may not be present in the sample.

PP+ Volatiles (28 Analytes)
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
Methylene chloride
1,1,2,2-Tetrachloroethane
Tetrachloroethane
Toluene
Trichlorofluoromethane
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl chloride
Xylene

PP+Base/Neutral Semi-Volatiles (51 Analytes)	
Acenaphthylene	3,3'-Dichlorobenzidine
Acenaphthene e	Diethyphthalate
Aniline	Dimethylphthalate
Anthracene	1,2-Diphenylhydrazine
Benzidine	2,4-Dinitrotoluene
Benzo(a)anthracene	2,6-Dinitrotoluene
Benzo(b)fluoranthene	Di-n-octylphthalate
Benzo(k)fluoranthene	Fluoranthene
Benzo(g,h,i)perylene	Fluorene
Benzo(a) pyrene	Hexachlorobenzene
bis(2-Chloroethoxy)methane	Hexachlorobutadiene
bis(2-Chloroethyl)ether	Hexachlorocyclopentadiene
bis(2-Chloroisopropyl)ether	Hexaachloroethane
bis(2-Ethylhexyl)phthalate	Indeno(1,2,3-cd)pyrene
4-Bromophenyl-phenylether	Isophorone
Butyl benzyl phthalate	Naphthalene
4-Chloroaniline	1-Naphthylamine
2-Chloronaphthalene	2-Naphthylamine
4-Chlorophenyl phenyl ether	Nitrobenzene
Chrysene	n-Nitrosodimethylamine
Di-n-butylphthalate	n-Nitrosodiphenylamine
Dibenz(a,h)anthracene	n-Nitrosodi-n-propylamine
1,2-Dichlorobenzene	o-Toluidine
1,3-Dichlorobenzene	Phenanthrene
1,4-Dichlorobenzene	Pyrene
	1,2,4-Trichlorobenzene

CLF Volatiles
Benzene
Chlorobenzene
Chloroform
Methylene Chloride
Toluene
Trichloroethene

CLF Semi-Volatiles
Aniline
4-Chloroaniline
1,2-Dichlorobenzene
1,4-Dichlorobenzene
n-Nitrosodimethylamine
Naphthalene
o-Toluidine
1,2,4-Trichlorobenzene

PP+Acid Semi-Volatiles (11)
4-Chloro-3-methylphenol
2-Chlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2-Nitrophenol
4-Nitrophenol
Pentachlorophenol
Phenol
2,4,6-Trichlorophenol

PFCs (13 Analytes)	
Perfluorobutanoic Acid (PFBA)	Perfluoroundecanoic Acid (PFUnA)
Perfluoropentanoic Acid (PFPeA)	Perfluorododecanoic Acid (PFDoA)
Perfluorohexanoic Acid (PFHxA)	Perfluorobutane Sulfonic Acid (PFBS)
Perfluoroheptanoic Acid (PFHpA)	Perfluorohexane Sulfonic Acid (PFHxS)
Perfluorooctanoic Acid (PFOA)	Perfluorooctane Sulfonic Acid (PFOS)
Perfluorononanoic Acid (PFNA)	Perfluorooctane Sulfonamide (PFOSA)
Perfluorodecanoic Acid (PFDA	

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Table 2
QC Summary: Closure and Post-Closure
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	PP+ Volatiles (28)	PP+ Base/Neutral Semi-volatiles (49)	PP+ Acid Semi-volatiles (11)	Aluminum	Arsenic	Beryllium	Cadmium	Iron	Lead	Dis Lead	Nickel	Sodium	Total Organic Halogen	Total Organic Carbon	Temperature	Spec Conductance	pH	Dissolved Oxygen	Eh
G16-M02B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T
H13-M02B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
H14-M01B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T
H16-P01B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T
J16-M01B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T
K13-M02B*	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T
L14-M01B	7/9/2018	---	---	---	---	---	---	---	---	---	---	---	---	T(B)	T	T	T	T	T	T

* Well also sampled as part of PFOA Monitoring Program (see table 7) .
T = Test completed as scheduled.
--- = No sampling required.
T(B) = Sampled, result may be biased high or a false positive due to trip blank contamination.

AECOM

Table 3
QC Summary: Perimeter Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	PP+ Volatiles (28)	PP+ Volatiles (26)	PP+Base/Neutral Semi-volatiles (51)	PP+Acid Semi-volatiles (11)	PP+Base/Neutral Semi-volatiles (46)	Aluminum	Anitimony	Arsenic	Beryllium	Cadmium	Chromium	Cyanide	Iron	Lead	Dis Lead	Organic Lead	Mercury	Nickel	Selenium	Silver	Sodium	Thallium	Zinc	Total Organic Halogen	Total Organic Carbon	Temperature	Spec Conductance	pH	Dissolved Oxygen	Eh
J05-M02B	7/13/2018	T	---	T(9UJ, 1J)	T	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
L04-M01B	7/13/2018	T	---	T(10UJ)	T	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
J05-M01B	7/13/2018	---	T	---	---	T(3UJ, 1J)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
J05-M01C	7/13/2018	---	T	---	---	T(4UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
J04-M01B	7/13/2018	T	---	T(10UJ)	T	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(UJ)	T	T	T	T	T	T
I05-M01B	7/13/2018	T	---	T(7UJ, 3J)	T	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
F05-M06B	8/2/2018	T	---	T(2UJ, 1J)	T	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T	T	T	T	T	T	T
F06-M02B	7/16/2018	T	---	T(1B, 9UJ)	T	---	T	T	T(J)	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
G05-M02B	7/16/2018	T	---	T(4UJ, 7J)	T	---	T	T	T(J)	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C07-M01B	7/16/2018	T	---	T(8UJ)	---	---	T	T	T(J)	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C08-M01B*	7/16/2018	T	---	T(1B, 8UJ)	T	---	T	T	T(J)	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
D06-M01B**	7/16/2018	T	---	T(1B, 10UJ, 1J)	T	---	T	T	T(J)	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C09-M01B+	7/17/2018	T	---	T(10UJ, 1J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C10-M01B	7/17/2018	T	---	T(7UJ, 3J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C10-M03B	7/17/2018	T	---	T(11UJ)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
C11-M01C	7/17/2018	---	T	---	---	T(7UJ, 1J)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
C11-M01E	7/17/2018	---	T	---	---	T(8UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
C11-M02D**	7/17/2018	---	T	---	---	T(7UJ, 1J)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
C11-M03B	7/17/2018	T	---	T(6UJ, 1J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
D14-M01B	7/18/2018	T	---	T(1UJ, 5J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
D15-M01B**	7/18/2018	T	---	T(6UJ, 5J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(UJ)	T	T	T	T	T	T
E15-M01B	7/18/2018	T	---	T(7UJ, 4J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
E16-M01B	7/18/2018	T	---	T(7UJ, 4J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(J)	T	T	T	T	T	T
F16-M01B	7/18/2018	T	---	T(5UJ, 3J)	---	---	T	T	T	T	T	T	---	T	T	T	T	---	T	---	---	T	---	---	T(UJ)	T	T	T	T	T	T
G16-M03B	7/19/2018	T	---	T(1R, 1B, 2UJ, 2J)	---	---	T(J)	T	T	T	T	T(J)	---	T(J)	T	T	T	---	T(J)	---	---	T	---	---	T(B)	T	T	T	T	T	T
H17-M01B	7/19/2018	---	T	---	---	T(1R, 1UJ, 1J)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
H17-M01C	7/19/2018	---	T	---	---	T(1R, 1UJ, 1J)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
K18-P01B	7/19/2018	T	---	T(1R, 1B, 2UJ)	---	---	T(J)	T	T	T	T	T(J)	---	T(J)	T	T	T	---	T	---	---	T	---	---	T	T	T	T	T	T	T
R09-M01B	7/20/2018	---	T	---	---	T(1R, 9UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(J)	T	T	T	T	T	T
R09-M02C	7/20/2018	---	T	---	---	T(1R, 1UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
O26-M01B	7/20/2018	---	T	---	---	T(1R, 1UJ)	T	T	T	T	T	T	T	T	T	---	---	T	T	T	T	T	T	T(J)	T(R)	T	T	T	T	T	T
R31-M01B	7/20/2018	---	T	---	---	T(1R, 1UJ)	T	T	T	T	T	T	T	T	T	---	---	T	T	T	T	T	T	T(R)	T(J)	T	T	T	T	T	T
S32-M01B	7/20/2018	---	T	---	---	T(1R, 5UJ)	T	T	T	T	T	T	T	T	T	---	---	T	T	T	T	T	T	T(J)	T(J)	T(J)	T	T	T	T	T
U08-M01B	7/23/2018	---	T	---	---	T(1R, 3UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
U12-M01A	7/23/2018	---	T	---	---	T(1R, 3UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
U12-M01B	7/23/2018	---	T	---	---	T(1R, 3UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
R09-R01D	7/23/2018	---	T	---	---	T(6UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T	T	T	T	T	T	T
N04-M01B	7/24/2018	---	T	---	---	T(5UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T
N04-M01C	7/24/2018	---	T	---	---	T(5UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T
N04-M01D	7/24/2018	---	T	---	---	T(5UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T
P06-M01B**	7/24/2018	---	T	---	---	T(6UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T
P06-M01D**	7/24/2018	---	T	---	---	T(5UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T
P06-M02C	7/24/2018	---	T	---	---	T(1R, 6UJ)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	T(UJ)	T	T	T	T	T	T

Table 3
QC Summary: Perimeter Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

T = Test completed as scheduled.
--- = No sampling required.
* Well also sampled as part of Post Closure Monitoring for RCRA Units Program (see table 6) and PFOA Monitoring Program (see table 7).
** Well also sampled as part of PFOA Monitoring Program (see table 7).
+ Well also sampled as part of Post Closure Monitoring for RCRA Units Program (see table 6).
T(R) = Sampled, result is unusable due to a very poor lab matrix spike recoveries.
T(1R, 1B, 2UJ, 2J) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; the result for one base/neutral semi volatile compound may be biased high or a false positive due to field equipment blank contamination; estimated results for two base/neutral semi-volatile compounds, and non-detect result for two additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(1R, 1B, 2UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; the result for one base/neutral semi-volatile compound may be biased high or a false positive due to field equipment blank contamination; and non-detect result for two additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(1R, 1UJ, 1J) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; estimated result for one base/neutral semi-volatile compound, and non-detect result for one additional base/neutral semi-volatile compound have estimated reporting limits, due to poor lab blank spike recoveries.
T(1R, 1UJ, 2J) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; estimated results for two base/neutral semi-volatile compounds, and non-detect result for one additional base/neutral semi-volatile compound has estimated reporting limits, due to poor lab blank spike recoveries.
T(1R, 1UJ, 2J) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; estimated results for two base/neutral semi-volatile compounds, and non-detect result for one additional base/neutral semi-volatile compound has estimated reporting limits, due to poor lab blank spike recoveries.
T(1R, 3UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; and non-detect results for three additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(1R, 5UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; and non-detect results for five additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike or matrix spike recoveries.
T(1R, 6UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; and non-detect results for six additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike or matrix spike recoveries.
T(1R, 9UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; and non-detect results for nine additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(1R, 1UJ) = Sampled, the non-detect result for benzidine is unusable due to a very poor lab blank spike or matrix spike recovery; and the non-detect result for one additional base/neutral semi-volatile compound has an estimated reporting limit, due to a poor lab blank spike recovery.
T(B) = Sampled, result may be biased high or a false positive due to field equipment blank contamination.
T(1B, 10UJ, 1J) = Sampled, the result for one base/neutral semi-volatile compound may be biased high or a false positive due to field equipment blank contamination; an estimated result for one additional base/neutral semi-volatile compounds and non-detect results for ten additional base/neutral semi-volatile compound have estimated reporting limits, due to poor lab blank spike or matrix spike recoveries or due to preparation hold time exceedance.
T(1B, 9UJ) = Sampled, the result for one base/neutral semi-volatile compound may be biased high or a false positive due to field equipment blank contamination and non-detect results for nine additional base/neutral semi-volatile compound have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(1B, 8UJ) = Sampled, the result for one base/neutral semi-volatile compound may be biased high or a false positive due to field equipment blank contamination and non-detect results for eight additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(1B, 7UJ) = Sampled, the result for one base/neutral semi-volatile compound may be biased high or a false positive due to field equipment blank contamination and non-detect results for seven additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(J) = Sample, estimated result due to poor or very poor matrix spike recovery, or poor lab duplicate precision.
T(UJ) = Sample, estimated reporting limit for non-detect result due to very poor matrix spike recovery.
T(4UJ) = Sampled, non-detect results for four base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(5UJ) = Sampled, non-detect results for five base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank spike recoveries.
T(6UJ) = Sampled, non-detect results for six base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank or matrix spike recoveries.
T(8UJ) = Sampled, non-detect results for eight base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(10UJ) = Sampled, non-detect results for ten base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank spike recoveries. or due to preparation hold time exceedance.
T(11UJ) = Sampled, non-detect results for eleven base/neutral semi-volatile compounds have estimated reporting limits due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(1UJ, 5J) = Sampled, estimated results for five base/neutral semi-volatile compounds, and non-detect result for one additional base/neutral semi-volatile compound has estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(2UJ, 1J) = Sampled, estimated result for one base/neutral semi-volatile compound, and non-detect results for two additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(3UJ, 1J) = Sampled, estimated results for one base/neutral semi-volatile compound, and non-detect results for three additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(4UJ, 7J) = Sampled, estimated results for seven base/neutral semi-volatile compounds, and non-detect results for four additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(5UJ, 3J) = Sampled, estimated result for three base/neutral semi-volatile compounds, and non-detect results for five additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(6UJ, 1J) = Sampled, estimated result for one base/neutral semi-volatile compound, and non-detect results for six additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.

Table 3
QC Summary: Perimeter Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

T(6UJ, 5J) = Sampled, estimated results for five base/neutral semi-volatile compounds, and non-detect results for six additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(7UJ, 4J) = Sampled, estimated result for four base/neutral semi-volatile compounds, and non-detect results for seven additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(7UJ, 3J) = Sampled, estimated result for three base/neutral semi-volatile compounds, and non-detect results for seven additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.
T(7UJ, 1J) = Sampled, estimated result for one base/neutral semi-volatile compound due to preparation hold time exceedance and non-detect results for seven additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(9UJ, 1J) = Sampled, estimated result for one base/neutral semi-volatile compound , and non-detect results for nine additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries.
T(10UJ, 1J) = Sampled, estimated result for one base/neutral semi-volatile compound , and non-detect results for ten additional base/neutral semi-volatile compounds have estimated reporting limits, due to poor lab blank spike recoveries or due to preparation hold time exceedance.

AECOM

Table 4
QC Summary: C Landfill Corrective Action Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	CLF Volatiles (6)	CLF Semi-volatiles (8)	Aluminum	Arsenic	Lead	Sodium	Ammonia	Chloride	Cyanide	Nitrate	Phenolics	Sulfate	Total Organic Halogen	Total Organic Carbon	Temperature	Spec Conductance	pH	Dissolved Oxygen	Eh
P21-M01B++	7/12/2018 & 8/7/2018 & 8/14/2018	T	T(2J, 1UJ)	T	T	T	T	T	T	T(UJ)	T	T	T	T(B)	T	T	T	T	T	T
P21-M04B*	7/12/2018 & 8/7/2018	T	T(3UJ)	T	T	T	T	T	T	T(UJ)	T	T	T	T(B)	T	T	T	T	T	T
P21-R01B^	7/12/2018 & 8/7/2018	T	T(1J, 3UJ)	T	T	T	T	T	T	T(UJ)	T	T	T	T(B)	T	T	T	T	T	T
Q20-R01B^^	8/7/2018 & 8/13/2018	T	T(1UJ)	T(B)	T	T	T	T	T	T(J)	T	T	T	T(J)	T	T	T	T	T	T
Q21-M01B	7/12/2018 & 8/7/2018	T	T(4UJ)	T	T	T	T	T	T	T(J)	T	T	T	T(J)	T	T	T	T	T	T

T = Test completed as scheduled.
--- = No sampling required.
* P21-M04B is the replacement well for P21-M03B which was abandoned.
^ P21-R01B is the replacement well for R20-M01B which was abandoned.
^^ Q20-R01B is the replacement well for Q20-M02B which was abandoned.
++ Well also sampled as part of PFOA Monitoring Program (see table 7).
T(B) = Sampled, result may be biased high or a false positive due to lab method blank or field equipment blank contamination
T(J) = Sampled, estimated result due to a poor or very poor matrix spike recovery.
T(UJ) = Sampled, non-detect reporting limit is considered to be estimated due to poor lab matrix spike recovery.
T(1UJ) = Sampled, non-detect reporting limit for one semivolatile compound is considered to be estimated due to a poor lab blank spike recovery.
T(3UJ) = Sampled, non-detect reporting limits for three semivolatile compounds are considered to be estimated due to poor lab blank spike, or poor lab blank spike and poor lab matrix spike recoveries.
T(4UJ) = Sampled, non-detect reporting limits for four semivolatile compounds are considered to be estimated due to poor lab blank spike recoveries.
T(2J, 1UJ) = Sampled, two semivolatile results and one semivolatile non-detect reporting limit are considered to be estimated due to poor lab blank spike recoveries.
T(1J, 3UJ) = Sampled, one semivolatile result and three semivolatile non-detect reporting limits are considered to be estimated due to poor lab blank spike or poor lab matrix spike recoveries.

Table 5
QC Summary: C Landfill Detection Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	CLF Volatiles (9)	CLF Semi-volatiles (8)	Aluminum	Arsenic	Lead	Sodium	Ammonia	Chloride	Cyanide	Nitrate	Phenolics	Sulfate	Total Organic Halogen	Total Organic Carbon	Temperature	Spec Conductance	pH	Dissolved Oxygen	Eh
R19-M01B	7/11/2018	T	T(10UJ)	T	T(J)	T(J)	T	T	T(J)	T	T	T	T	T(J)	T(J)	T	T	T	T	T
R19-M02B	7/11/2018	T	T(4UJ)	T	T(J)	T(J)	T	T	T	T	T	T	T	T(J)	T	T	T	T	T	T
S19-M01B	7/11/2018	T	T(4UJ)	T	T	T(J)	T	T	T	T	T	T	T	T(J)	T	T	T	T	T	T
S19-M02B	7/11/2018	T	T(4UJ)	T	T	T	T	T	T	T	T	T	T	T(J)	T	T	T	T	T	T
S24-M01B	7/11/2018	T	T(1UJ)	T	T(J)	T	T	T	T	T	T	T	T	T(UJ)	T	T	T	T	T	T
T22-M01B	7/11/2018	T	T(1UJ)	T	T	T	T	T	T	T	T	T	T	T(J)	T(J)	T	T	T	T	T

T = Test completed as scheduled.
--- = No sampling required.
T(J) = Sampled, estimated result due to poor matrix spike recovery or poor field duplicate precision.
T(UJ) = Sampled, non-detect result is estimated due to poor matrix spike recovery.
T(1UJ) = Sampled, non-detect result for one semivolatile compound is estimated due to poor lab blank spike recovery.
T(4UJ) = Sampled, non-detect results for four semivolatile compounds are estimated due to poor lab blank spike recovery.
T(10UJ) = Sampled, non-detect results for six semivolatile compounds are estimated due to poor lab blank spike or matrix spike recovery.

Table 6
QC Summary: Post-Closure Monitoring for RCRA Units Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	Iodide	Fluoride	Lead	Antimony	PCB Congeners (209)	Ethylene Diclhoride, Ethylene Dibromide
C08-M01B*	7/16/2018	T	T	---	---	---	---
C09-M01B**	7/17/2018	---	---	T	---	---	---
G14-M01B	7/19/2018	---	---	---	T	T(8J, 34B)	---
L12-M01B	7/19/2018	---	---	T	---	---	T

* Well also sampled as part of Perimeter Monitoring Program (see table 3) and PFOA Monitoring Program (see table 7).
** Well also sampled as part of Perimeter Monitoring Program (see table 3)
T = Test completed as scheduled.
--- = No sampling required.
T(8J, 34B) = Sampled, results for eight congeners should be considered to be estimated due to poor field duplicate precision, and results for 34 congeners may be biased high or false positives due to field equipment or lab blank contamination.

Table 7
QC Summary: PFOA Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	PFCs
AA22-M01B	08/06/2018	T
AA25-M01B	07/30/2018	T
AA25-M01C	07/30/2018	T
C08-M01B*	07/16/2018	T
C11-M01C	07/17/2018	T
C11-M01E	08/13/2018	T
C11-M02D**	07/17/2018	T
C11-M03B	07/17/2018	T(1B)
D06-M01B**	07/16/2018	T
D15-M01B**	07/18/2018	T
F07-M01B	07/26/2018	T
F08-M01A	08/13/2018	T(1J)
F08-M01B	07/26/2018	T
G04-M01B	07/25/2018	T
G04-M01E	07/25/2018	T
G05-M02B	08/13/2018	T
G09-M01A	07/10/2018	T
J04-M01B	07/13/2018	T
J05-M01C	07/13/2018	T
J10-M02B++	07/10/2018	T
K12-M01A	07/10/2018	T
K13-M02B+	07/19/2018	T
L09-M01B	07/31/2018	T
L09-M01C	07/31/2018	T
L09-M01D	08/07/2018	T
N08-M01B	07/27/2018	T
N08-M01C	07/27/2018	T
N08-M01D	07/27/2018	T(1J)
P06-M01B**	07/24/2018	T
P06-M01D**	07/24/2018	T
P06-M01E	07/25/2018	T
P06-M02C	07/24/2018	T(1UJ)

Table 7
QC Summary: PFOA Monitoring Program
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Well Identification	Sample Date	PFCs
P21-M01B++	07/12/2018	T
Q12-M01B	07/30/2018	T
R09-M02B	07/26/2018	T
R10-M01C	07/26/2018	T
R10-M01E	07/26/2018	T
R12-M01A(B)	07/30/2018	T
Z28-M01B	08/13/2018	T

PFCs = Perfluorinated compounds

* Well also sampled as part of Perimeter Monitoring Program (see table 3) and Post Closure Monitoring for RCRA Units Program (see table 6).

** Well also sampled as part of Perimeter Monitoring Program (see Table 3).

+ Well also sampled as part of Closure and Post Closure Program (see Table 2).

++ Well J10-M01B collapsed and could not be sampled; the well was subsequently abandoned and replaced by J10-M02B.

T = Test completed as scheduled.

T(1B) = Sampled, result for one target compound may be biased high or a false positive due to field equipment blank contamination.

T(1J) = Sampled, estimated result for one target compound due to poor field duplicate precision or poor surrogate spike recovery.

T(1UJ) = Sampled, the non-detect reporting limit for one target compoun is an estimated value due to poor surrogate spike recovery.

AECOM

Table 8
Summary of Accuracy, Precision, and Representativeness Measures for Assays
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Test/Parameter	No. Tests*	Accuracy	Precision	Represent-ativeness	Completeness	Tests Done %
C-Landfill Volatiles (6)	5	100.0%	100.0%	100.0%	100.0%	100.0%
C-Landfill Volatiles (9)	6	100.0%	100.0%	100.0%	100.0%	100.0%
PP+ Volatiles (26)	22	100.0%	100.0%	100.0%	100.0%	100.0%
PP+ Volatiles (28)	21	100.0%	100.0%	100.0%	100.0%	100.0%
Ethylene dichloride, Ethylene dibromide	1	100.0%	100.0%	100.0%	100.0%	100.0%
C-Landfill Semivolatiles (8)	11	55.7%	100.0%	100.0%	100.0%	100.0%
PP+ Base/Neutral Semivolatiles (46)	22	90.1%	100.0%	100.0%	98.9%	100.0%
PP+ Base/Neutral Semivolatiles (51)	21	83.1%	99.9%	99.5%	99.8%	100.0%
PP+ Base/Neutral Acids (11)	9	100.0%	100.0%	100.0%	100.0%	100.0%
PCB Congeners (209)	1	100.0%	96.2%	83.7%	100.0%	100.0%
PFCs (13)	39	99.6%	99.8%	99.8%	100.0%	100.0%
Metals:	323	96.0%	97.8%	99.7%	99.7%	100.0%
Aluminum	35	100.0%	94.3%	97.1%	100.0%	100.0%
Antimony	25	100.0%	100.0%	100.0%	100.0%	100.0%
Arsenic	35	77.1%	100.0%	100.0%	100.0%	100.0%
Beryllium	24	100.0%	100.0%	100.0%	100.0%	100.0%
Cadmium	24	100.0%	100.0%	100.0%	100.0%	100.0%
Chromium	24	100.0%	91.7%	100.0%	100.0%	100.0%
Iron	24	100.0%	91.7%	100.0%	100.0%	100.0%
Lead	37	91.9%	100.0%	100.0%	100.0%	100.0%
Dis. Lead	21	100.0%	100.0%	100.0%	100.0%	100.0%
Mercury	3	100.0%	100.0%	100.0%	100.0%	100.0%
Nickel	24	100.0%	95.8%	100.0%	100.0%	100.0%
Selenium	3	100.0%	100.0%	100.0%	100.0%	100.0%
Silver	3	100.0%	100.0%	100.0%	100.0%	100.0%
Sodium	35	100.0%	100.0%	100.0%	100.0%	100.0%
Thallium	3	100.0%	100.0%	100.0%	100.0%	100.0%
Zinc	3	33.3%	100.0%	100.0%	66.7%	100.0%
Ammonia	11	100.0%	100.0%	100.0%	100.0%	100.0%
Chloride	11	100.0%	90.9%	100.0%	100.0%	100.0%
Cyanide	14	64.3%	100.0%	100.0%	100.0%	100.0%
Fluoride	1	100.0%	100.0%	100.0%	100.0%	100.0%
Iodide	1	100.0%	100.0%	100.0%	100.0%	100.0%
Nitrate	11	100.0%	100.0%	100.0%	100.0%	100.0%
Organolead	21	100.0%	100.0%	100.0%	100.0%	100.0%
Phenolics	11	100.0%	100.0%	100.0%	100.0%	100.0%
Sulfate	11	100.0%	100.0%	100.0%	100.0%	100.0%
TOC	61	95.1%	100.0%	100.0%	100.0%	100.0%
TOX	61	34.4%	100.0%	83.6%	98.4%	100.0%
Dis Oxygen	61	100.0%	100.0%	100.0%	100.0%	100.0%
pH	61	100.0%	100.0%	100.0%	100.0%	100.0%
Redox	61	100.0%	100.0%	100.0%	100.0%	100.0%
Specific Conductance	61	100.0%	100.0%	100.0%	100.0%	100.0%
Temperature	61	100.0%	100.0%	100.0%	100.0%	100.0%
Totals**	**5073**	**92.2%**	**99.6%**	**99.0%**	**99.7%**	**100.0%**

* Number of tests = number of samples.
** Totals = number of analytes.
PFCs = Perfluorinated compounds

Table 9
Summary of Field Duplicate Results
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Test/Parameter	Duplicate Results Meeting Criteria	
Volatiles	97 / 97	100.0%
Semivolatiles	168 / 172	97.7%
PFCs (13)	79 / 80	98.8%
PCB Congeners	87 / 209	41.6%
Metals:	34 / 34	100.0%
Aluminum	4 / 4	100.0%
Antimony	2 / 2	100.0%
Arsenic	4 / 4	100.0%
Beryllium	2 / 2	100.0%
Cadmium	2 / 2	100.0%
Chromium	2 / 2	100.0%
Iron	2 / 2	100.0%
Lead	4 / 4	100.0%
Dis. Lead	1 / 1	100.0%
Mercury	1 / 1	100.0%
Nickel	2 / 2	100.0%
Selenium	1 / 1	100.0%
Silver	1 / 1	100.0%
Sodium	4 / 4	100.0%
Thallium	1 / 1	100.0%
Zinc	1 / 1	100.0%
Ammonia	2 / 2	100.0%
Chloride	1 / 2	50.0%
Cyanide	3 / 3	100.0%
Nitrate	2 / 2	100.0%
Organolead	1 / 1	100.0%
Phenolics	2 / 2	100.0%
Sulfate	2 / 2	100.0%
Total Organic Carbon	5 / 5	100.0%
Total Organic Halogen	5 / 5	100.0%
All tests	**488 / 616**	**79.2%**

Notes: Values reported above for Volatiles, Semivolatiles, PFCs, and PCB Congeners are per analyte.
PFCs = Perfluorinated compounds

Table 10
Eurofins Lancaster Laboratory Proficiency Test Sample Results Summary
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Category	WP-258/259*	WP-264**	WP-276***
Trace Metals	168 / 168	147 / 147	168 / 168
Minerals	29 / 31	32 / 32	39 / 44
Nutrients	13 / 13	12 / 12	13 / 15
Demands	0 / 0	6 / 6	5 / 7
Polychlorinated Biphenyls	21 / 21	21 / 21	21 / 21
Pesticides	66 / 66	66 / 66	5 / 5
Volatiles+	223 / 223	220 / 220	223 / 223
Miscellaneous Parameters	46 / 51	48 / 50	77 / 77
Overall Performance	566 / 573	552 / 554	551 / 560
	98.8%	99.6%	98.4%

* Environmental Resource Associates, September/October 2016.
** Environmental Resource Associates, March 2017.
*** Environmental Resource Associates, March 2018.
+ Previously reported as Volatile Halocarbons and Volatile Aromatics - categories combined to reflect Environmental Resource Associates reporting.

Table 11
AECOM 2018 Personnel Records
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Employee Name	40 Hour OSHA Training (OSHA 29 CFR 1910.120)	8 Hour OSHA Training (OSHA 29 CFR 1910.120)	Respirator Fit Test	Medical Examination	8 Hour Supervisor Training (OSHA 29 CFR 1910.120)
Derek Knowles	4/18/2011	8/7/2018	4/11/2019	1/3/2019	4/11/2013
Don Layman	4/12/1993	8/7/2018	--	8/22/2018	6/9/1996
Katie Lombardo	6/16/2008	8/7/2018	9/11/2017	1/25/2019	12/30/2010
Gina Marinacci	11/16/2018	--	4/11/2019	11/19/2018	--
Jenna Outwater	11/15/2018	--	--	11/5/2018	--
Unitas Todd	9/12/2003	8/7/2018	4/11/2019	8/15/2018	3/18/2004

Table 12
AECOM 2018 Monthly Safety Meetings
Second Semester 2018 Discharge to Groundwater Permit Semi-Annual Quality Assurance Report
Chemours Chambers Works
Deepwater, New Jersey

Month	Training	Topics
July	Safety	The Power of Water - Drowning Safety
August	Safety	Safety While Hiking
September	Safety	Quarterly Safety Focus
October	Safety	Fall and Fire Safety
November	Safety	Fit for Duty - Managing Holiday Stress
December	Safety	Winter Safety